HANDBOOK of FOOD AND DIET

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HANDBOOK
OF
FOOD AND DIET

A COMPLETE FOOD COURSE

COMPRISING

CHEMISTRY OF THE HOUSEHOLD

BY
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CHICAGO
AMERICAN SCHOOL OF HOME ECONOMICS
1912

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CHEMISTRY OF THE HOUSEHOLD

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CHICAGO
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AMERICAN SCHOOL OF HOME ECONOMICS

CHICAGO

January 1, 1907.

My dear Madam:

The chemistry of housework is a subject so varied that new problems arise almost every day and new methods of attacking old problems are constantly to be discovered. In all this complication, a few underlying principles are unalterable and will help us to right conclusions.

These lessons are by no means complete and an experienced housekeeper will think of many questions which are unanswered and methods of work that she herself employs which are not mentioned here. I hope that you will tell me of your own methods and experiences and I especially want you to ask questions so that we may supplement the lessons together.

Many of the subjects which are only touched upon in this series are taken up fully from a different standpoint in later lessons.

I am indebted to my revered friend and teacher, Mrs. Ellen H. Richards, for the suggestion of the treatment of the subject in the order of "A Day's Chemistry" and for the use of material in her published books.

There is no BEST rule of universal application for circumstances vary so widely, but the reason why some methods produce good results are here set forth.

In the study of these lessons I would advise taking up one subject at a time, illustrating it by the experiments suggested and by others

which may occur to you. After considering each topic in detail in this way, read the whole lesson over carefully. When puzzled over anything, make a note of the difficulty and if you do not discover an explanation for yourself, write to the School for assistance.

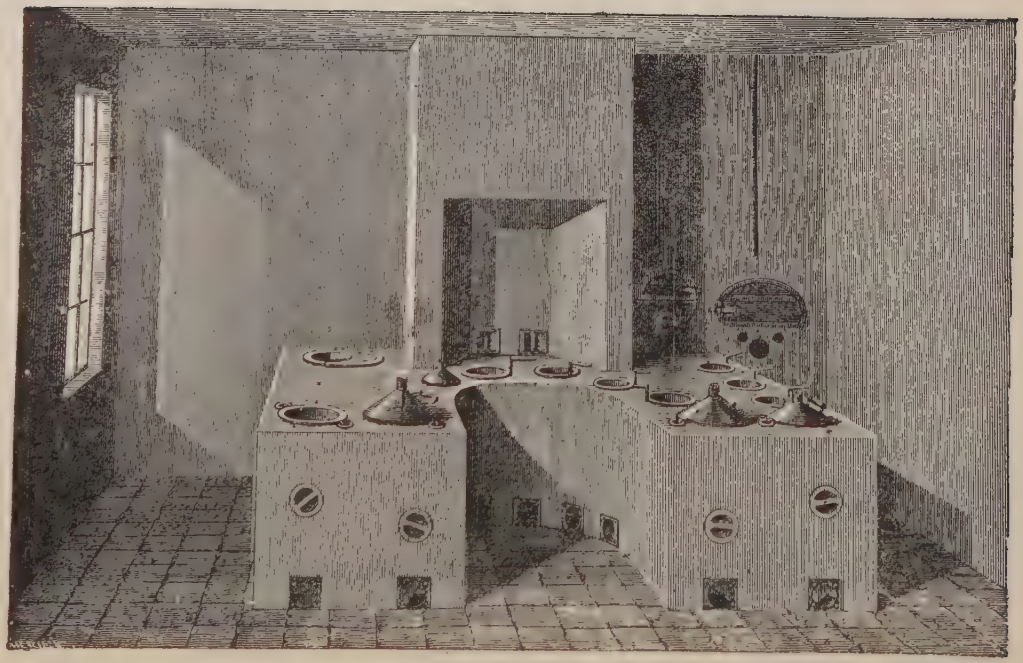
As you know from your own experience, work that really interests does not prove as fatiguing as mere drudgery. An intelligent interest in the reason "why" of daily happenings will surely make your daily duties go more easily and may lead you to discover simpler and more effective methods.

And so I wish you much success and pleasure in following this brief study of "A Day's Chemistry".

Very sincerely yours,

Margaret E. Dodd

Instructor



COUNT RUMFORD'S KITCHEN IN WHICH HE MADE EXPERIMENTS ON FUEL AND COOKING

Courtesy of Mrs. Ellen H. Richards

CHEMISTRY OF THE HOUSEHOLD

A Day's Chemistry

BEING an outline of the simplest and most evident chemical changes suggested by a day's work at home and a description of the various chemical substances of interest to the housewife.

WATER

Its Occurrence

The morning bath will introduce us agreeably to the wonderful chemical substance, water, and with this substance we will begin our study of a day's chemistry. The water for the house may come from the town supply, from wells, cisterns, or springs. It may be "surface water," from pond, lake, or stream, or it may be "ground water," from wells or deep springs. Cistern water is, of course, rain water. Water is present in many substances where we might not suspect it. All living things contain a large percentage of water. Of an athlete weighing 150 pounds, all but about 42 pounds is water. Wood, meat, vegetables, fruit, when dried, weigh from 50 to 98 per cent less. Many natural and artificial substances owe their crystalline form to

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water and when heated, give off this "water of crystallization" and crumble to powder. Common washing soda shows this effect, when exposed to the air, and soon gives off so much water that its crystalline character is lost.

Natural Water

All water found in nature is more or less impure, that is, it contains substances in solution. It dissolves air and takes substances from the soil and rocks over which it runs. Often it comes in contact with animal and vegetable substances and dissolves something from them. Near dwellings the water in streams, ponds, and wells is very likely to become contaminated. Decaying substances give rise to materials easily dissolved in water, which may travel for a considerable distance under ground, so that the drainage from the house or barn is frequently carried to near-by streams or wells, making their waters quite unfit to drink. Fig. 1.

The following experiment will illustrate that air is dissolved in water.

Experiment. Place a tumbler of fresh well-water or tap-water in a warm place. After a time, bubbles will be seen collecting on the sides of the glass. This is air which was dissolved in the water. As the water grows warm, it cannot hold so much air in solution and some of it separates.

Distilled Water

Most of the impurities in water are less easily converted into vapor than the water itself; hence, when the water is boiled, they stay behind while the water "boils away". Water from almost any source can be made pure and clear by distillation. Distilled water is

prepared in an apparatus known as a still. See Fig. **2.** A still consists of a boiler, A, and a condenser. In the condenser, a coil of tube, D, usually made of pure

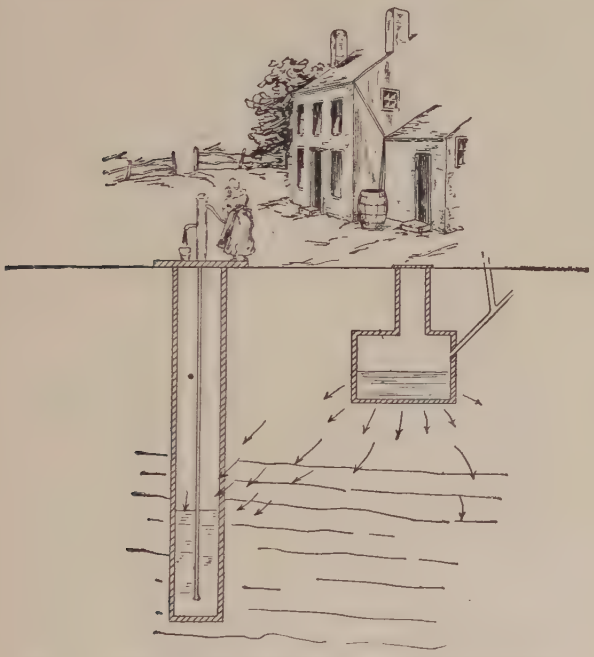

FIG. 1. WELL, CONTAMINATED BY HOUSE DRAINAGE.

tin, is surrounded by cold water which continually runs through the apparatus. The steam, admitted at the upper end of the coil, is condensed by the low temperature and distilled water is collected at the lower

end. In the laboratory, distilled water is often made in the glass apparatus shown in Fig. 3.

Distilled water has a flat taste, because air and other dissolved substances which give water its taste have been removed. It will again dissolve the air on being poured several times from one vessel into another.

Rain Water

Rain is water which has been evaporated from the surfaces of natural bodies of water, oceans, lakes, and from the land, and is practically free from mineral matter, but contains dissolved gases.

The vapor, cooled at the low temperatures of the upper levels of air, falls as rain. The first fall of any

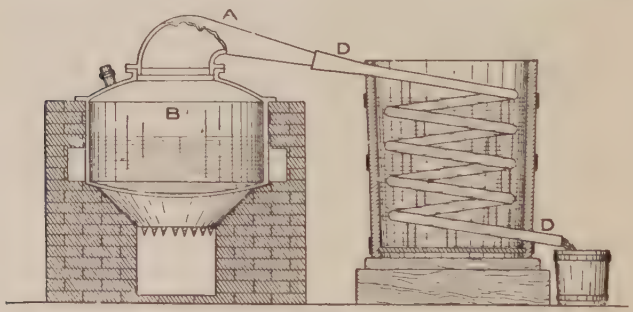

FIG. 2. A STILL.
A, Gooseneck; B, Boiler; D, Condensing Coil.

shower is mixed with impurities which have been washed from the air. Among these may be carbon dioxide, ammonia, and carbon in the form of soot and creosote. It is these last impurities which cause the

almost indelible stain left when rain water stands upon window-sills or other finished woods.

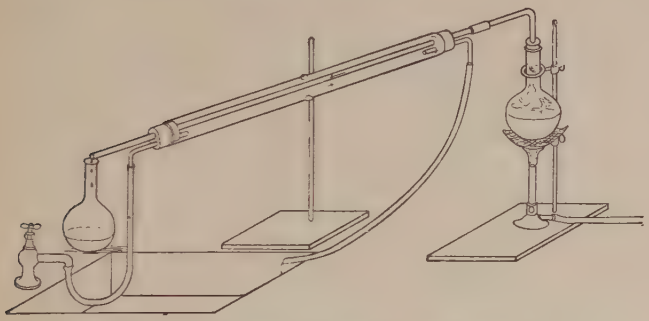

Fig. 3. Making Distilled Water in the Laboratory.

Solubility

Water is a nearly universal solvent. It dissolves more substances and these in larger quantities than any other liquid. At a given temperature, water will dissolve only a certain proportion of the various salts and other soluble substances. When the water will take up no more, the solution is said to be *saturated*. Increasing the temperature generally increases the dissolving power of water for solids and liquids. The reverse is usually true for gases.

When a saturated solution of a solid is cooled, crystals are frequently formed, many having beautiful shapes. Examples are shown in Fig. 4.

Experiment. In an earthen-ware or enameled dish dissolve as much alum as possible in a little boiling water. Pour the solution into a shallow dish or sau-

cer, and set it away for a day or more where it will be undisturbed. Beautiful, clear, six-sided crystals will form in the dish. If strings are hung in the solution, the crystals will form upon them. Rock candy crystals are made from cane sugar syrup in this way.

The experiment may be repeated, using washing soda instead of alum.

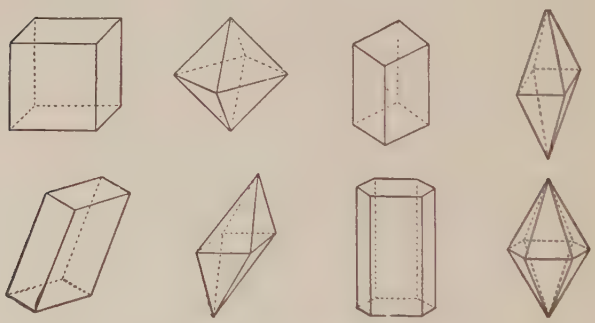

FIG. 4. SHAPES OF CRYSTALS.

Effect of Water on Metals

Silver, copper, and tin are not perceptibly dissolved in pure water, but when combined with acid substances, the compounds formed are soluble. These compounds of a metal with an acid are called salts. The salts of copper, zinc, and lead are poisonous. Copper, brass, (an alloy of copper with zinc) tin, solder, and iron are metals easily affected by acids, so that cooking utensils made of these materials should not be used with acid substances like lemon and vinegar.

Effect of Water on Lead

Lead pipes are much used in plumbing, and as a rule no evil results follow, since ordinary drinking water acts under most circumstances only very slightly upon lead. The pipes are soon coated with a layer of carbonate and sulphate of lead, which is insoluble and prevents any further action. Water from new lead pipes, or pipes not kept constantly full, or from a hot-water system in which lead is used, should never be used for drinking or cooking because of danger from poisoning. Pure distilled water, or rain water, affects lead more than ordinary ground water.

Hard Water

Rain water absorbs more or less carbon dioxide gas from the air and soaking into the soil often comes in contact with magnesia in the rocks and with limestone. Water containing this gas will dissolve these mineral substances making what is known as "hard" water, a very different substance from the original rain water which is "soft." This subject will be discussed when the chemistry of the laundry is explained.

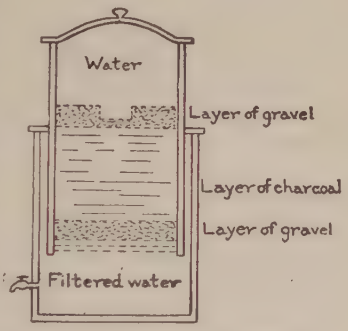

FIG. 5. A WATER FILTER.

Filtering

Ordinary water for drinking purposes is often filtered. Filtration will remove small particles suspended in the water, but has no effect on substances dissolved in it.

The small charcoal or sand filters will not remove

the minute living forms called micro-organisms or germs, some of which are the cause of disease. A filter of porous stone or procelain, in which the water filters slowly, is more effective. A good filter is shown in Figure 5.

Water which has strained or filtered through several feet of earth is often much improved, but the earth filter itself may become contaminated after a while and more harm than good result. A thick layer of sand and rock, however, removes germs effectively, and consequently water from deep driven wells is safe.

Composition of Water

Water was long considered an elementary or simple substance, but towards the end of the last century it was found to consist of two quite different substances so intimately joined together that the identity of each is lost. If we pass an electric current through water in the proper way, we see a gas rising in bubbles from the end of the wire by which the current enters and a like appearance at the wire by which the current leaves the water. The two gases have evidently come from the water and are the substances out of which it is made for the water begins to disappear. By placing an inverted glass filled with water over each wire, the gases are easily collected. See Fig. 6. When one bottle is *full* of gas, the other will be only *half full*; and on decomposing the whole of a given amount of water, this proportion holds true.

If we test these gases, we shall find them quite different. The bottle which is full contains a gas called

hydrogen. There is evidently twice as much of this by volume in water as of the other gas which is called oxygen. These two gases were tied together by what is known as *chemical force,* but the electric current separated them and gave us an opportunity to make the acquaintance of each by itself. We would hardly suppose this clear, colorless liquid to be composed of such material. On decomposing pure water from any

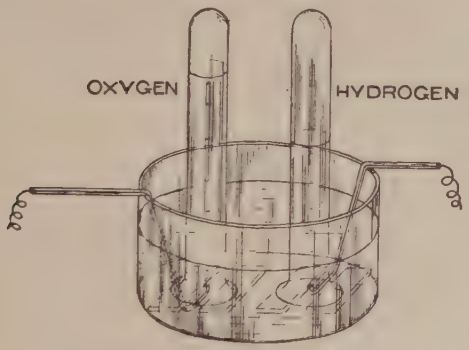

Fig. 6. Decomposing Water Into Oxygen and Hydrogen Gas.

source, the proportion of oxygen to hydrogen is always the same, and in fact, all *chemical compounds* have a *certain composition* which never varies under any condition.

Hydrogen

The name hydrogen comes from two Greek words, meaning *water* and *to produce.* Hydrogen is interesting as being the lightest common substance. It is an invisible gas like air, but unlike air will burn. If a

lighted candle be placed in a bottle of hydrogen, the flame will be at once extinguished, though the hydrogen will take fire at the mouth of the bottle. Fig. 7. Hydrogen will unite with other substances besides oxygen; that is, it will join with other substances by chemical force. It forms a part of most animal and vegetable substances.

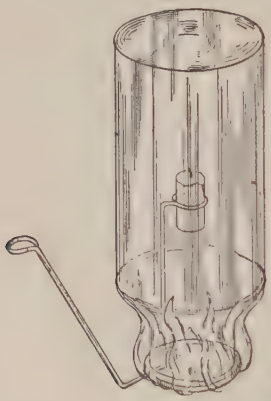

Fig. 7. Hydrogen Will Burn in Air.

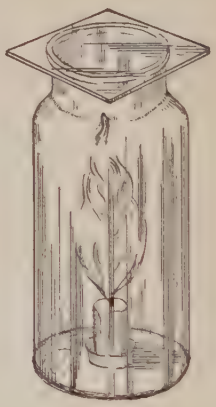

Fig. 8. A Candle Burns Vigorously in Oxygen.

Oxygen

Oxygen, as well as hydrogen, is a tasteless, colorless, odorless gas. The weight of a given volume is sixteen times that of the same volume of hydrogen. It is very abundant and the most important substance to mankind. Should we test this gas with a lighted candle, as we did the hydrogen, we would find that the oxygen would not give a flame, but that the candle would burn far more vigorously. Fig. 8.

When substances burn in oxygen they really unite with it chemically, forming new substances called *oxides*. Water is hydrogen united with oxygen and its chemical name might therefore be oxide of hydrogen.

Effect of Heating Water

When water is heated in an open vessel, evaporation from the surface of the liquid is more rapid as the temperature increases. Soon vapor is formed on the sides and bottom of the vessel and bubbles begin to rise which are at once condensed by the cooler parts of the liquid, thus making the familiar "singing" noise. Finally the liquid becomes so hot that the bubbles reach the surface without condensing, and then the water boils and goes off into the air as steam, an invisible gas. This occupies the small space between the spout of the tea-kettle and the cloud of vapor which is commonly called steam, but is really finely divided drops of water. A cubic inch of water makes about a cubic foot of steam.

Boiling Point

The temperature at which pure water begins to boil at sea level is 212° Fahrenheit (or 100° Centigrade) and this temperature remains the same while the boiling continues. Increasing the heat simply increases the violence of the boiling. The steam given off is of the same temperature as the boiling liquid. Most pure liquids have a definite boiling point; ether boils at 100° F, alcohol at 173° F, turpentine at 315° F.

When the pressure of the atmosphere on the surface of the liquid is less than at the sea level, as on a mountain, where there is not so much air above pressing down on the surface of the liquid, the temperature of

boiling is less. For example, the boiling point of water in Denver, Colorado, is about 202° F, and on the top of some of the mountains in the Himalayas, 180° F. People living in high mountain regions have difficulty in cooking with water or steam.

Increasing the pressure on the surface of the liquid, on the other hand, raises the boiling point. This is seen when water boils in a confined space, as in a steam boiler. Under five pounds pressure of steam, water boils at about 227° F and at 100 pounds pressure, at 337° F.

An increase in the boiling point of water is caused by dissolved substances. A very strong solution of common salt boils at about 226° F, and a solution of sugar—syrup or molasses—boils at an increasing temperature as the water is lost.

The temperature at which a syrup boils, is a measure of its thickness or density. In many modern cookery books temperature tests are given for boiling sugar in making confections, which vary from 215° for a thin syrup, up to 350° for caramel. In making maple sugar a "sugar thermometer" is often placed in the boiling syrup. At a given temperature, which is higher for sugar cakes than for soft sugar, the proper concentration is reached.

Latent Heat

Considerable heat is absorbed by the process of boiling. It requires 966 times as much heat to change a pound of water at the boiling point into steam as it does to raise it one degree Fahrenheit. The heat

which is used to change the state of the water without changing its temperature is called *latent heat* from the Latin word, meaning hidden. The "hidden heat" is given out again when the steam is condensed. This same quantity of heat is absorbed when the water evaporates slowly; hence the great cooling effect of large bodies of water.

Freezing

When water is cooled it shrinks slightly until the temperature of 39° F is reached. On further cooling it to the freezing point, 32° F (or 0° Centigrade) it increases in volume, so that ice takes up more space than the same weight of water and consequently floats. If this were not so, lakes and streams would freeze solid in winter and it is doubtful if they would melt completely during the summer in the northern part of the United States.

To melt ice, 144 times as much heat is required to change the ice at 32° F into water at 32° F, as to raise the temperature of the same quantity of water one degree Fahrenheit. This is the *latent heat of melting* and the same amount of heat is given out when water freezes. Water thus serves as the great temperature regulator for the earth, for by evaporating, much of the heat of summer is absorbed, and before freezing, a great deal of heat must be given out and absorbed.

Heat Absorption

Water has a much greater capacity of absorbing heat than any other common substance. For example, one pound of water will absorb ten times as much heat in being raised one degree as a pound of iron. The great-

er absorbing capacity of water for heat explains why a kettle of fat heats up so much faster than the same weight of water under like conditions; for the fat requires only one-third as much heat to raise it, say, to 200° F, as does the water.

THE ATMOSPHERE

When we leave the sleeping room, we open the windows to admit air. We may with advantage treat our lungs to an air bath by standing at the open window or by going out of doors for a few minutes to take in five or ten deep breaths. Next, perhaps, we shall use drafts of air to help us make a fire in the range or in a fire place.

Air as a Substance

Air is a real substance. It can be weighed. The air in a room 15 feet by 20 feet by 10 feet high weighs 210 pounds, and would fill ten ordinary water pails if liquified. Air will expand and may be compressed like other gases and it has been liquefied by intense cold and pressure. It requires considerable force to move it. When a bottle is full of air, no more can be poured in. Our houses are full of air all the time. It pervades all things—the cells and tissues of our bodies are full of air.

Wood and some metals even contain a little. In breathing we take a little from the room, but it is immediately replaced by expired air, which is impure. Were there no exits for this air, no pure air could enter the house, and we should die of slow suffocation. The

better built the house the quicker the suffocation. Fortunately no house is air tight. Air does pass out through the walls and cracks, and comes in around doors and windows, but unless there is a great difference in the temperature indoors and out, this fresh air is neither sufficient to replace the bad air nor to dilute it beyond harm. Therefore in ordinary weather, the air of all rooms must be often and completely changed either by special systems of ventilation or by intelligent action in the opening of doors and windows.

Air Pressure

The atmosphere surrounds the earth to a depth of fifty miles or more. The effect of gravity of the earth on this mass is to produce a pressure or weight of air on all things. This pressure is about fifteen pounds on each square inch, but we do not notice it, for the pressure is the same on all sides of us and the internal pressure in the cells of our bodies balances the external pressure of the atmosphere.

If it were not for the pressure of the air, we could not drink lemonade through a straw or pump a pail of water. When we exhaust part of the air by suction, we remove part of the pressure over the liquid in the straw and the air pressure on the surface in the glass forces the liquid up the straw. The same principle applies in a pump—the air is partially taken off the top of the water in the pipe, and then the pressure outside forces the water up in the pipe and by a proper valve arrangement, it is made to run into the pail. See Fig. 9.

The pressure of the atmosphere at the sea level is sufficient to force water up into a vacuum about 34 feet vertically; but owing to mechanical imperfections of pumps, the practical limit is 27 or 28 feet rise between the surface of the water and the valve of the pump. It is customary to use a force pump if water is to be raised to a height above this. Fig. 10.

Unlike water, air is not the result of a chemical union of two unlike simple gases. Nevertheless, air contains more than one substance. It is made up chiefly of two gases simply mixed together, and each exhibits its own characteristics to some extent.

Composition of Air

Pure air consists of oxygen, which we have found constitutes one-third of water, and of nitrogen (and argon). The oxygen forms about a fifth and the nitrogen four-fifths of the air. Besides these, several other gases are found in small but varying quantities.

To the oxygen gas is due the power of air to support combustion (fire) and life. Oxygen unites chemically with most other substances, and were the air all oxygen, the combustible part of the earth would soon be consumed by its own fires. Fortunately four-fifths of the air is a gas that has little power of combination and this nitrogen serves to dilute the oxygen and to weaken its force, much as water would dilute and weaken a strong and powerful chemical.

Nitrogen

The most marked characteristic of nitrogen is its sluggishness or inertness. Nitrogen, like oxygen, is a tasteless, odorless, colorless gas. It is fourteen

times as heavy as hydrogen. Though nitrogen from the air unites with other elements with difficulty, it is found in all living tissues, both animal and vegetable, and when these decompose the familiar substance, ammonia, is formed. This is a compound of hydrogen and nitrogen.

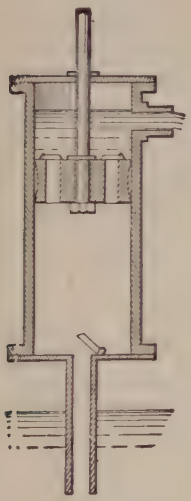

Fig. 9. Suction Pump.

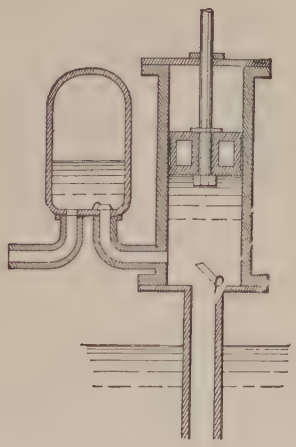

Fig. 10. Force Pump.

Carbon dioxide is always present in the atmosphere. This is one of the countless combinations of carbon, the element present in all animal and vegetable materials. Carbon is nearly pure in the form of charcoal. Soot, graphite or the black lead of lead pencils, and the

Carbon

diamond are other forms. Carbon unites very readily with oxygen and the gas formed by their chemical union is called carbon dioxide because it contains two parts of oxygen to one of carbon. Wood, coal, gas—almost everything that will burn in the air—and even our own bodies contain carbon, though we would not suspect its presence because it is combined with other substances and has merged its own character in those of the substances of which it forms a part. All our food contains carbon in its combinations.

Carbon Dioxide

When we breathe we take into our bodies the oxygen of the air. This oxygen is needed by the various organs and is carried in the blood from the lungs to all parts of the body. During the circulation the oxygen is taken up by the cells and replaced by carbon dioxide. This is brought back by the blood to the lungs and breathed out. If we remain long in a closed room, a portion of the oxygen of the air in the room and of the substance of our bodies is changed into carbon dioxide, which is unfit to breathe. This is the reason for the special need of ventilation in the sleeping room.

Water Vapor

Water in the form of vapor is constantly passing off into the air from the surface of bodies of water, from vegetation, and from animal organisms, as invisible vapor. The amount of water vapor present in the air is very variable. Warm air will hold more vapor than cold air. Ordinarily on a pleasant day, the atmosphere holds between 60 per cent and 70 per cent of the possible amount of water vapor.

Dew Point

When the air is saturated or at the dew point, a slight lowering of the temperature causes the vapor to condense. That air will absorb only a certain amount of moisture explains why a draft of air is necessary when drying clothes within doors and why the washing drys slowly on a damp day.

The presence of vapor in the air is shown by bringing a pitcher of ice water into a warm room. The air against the cold surface of the pitcher is cooled until the dew point is reached, when it deposits part of its moisture. Any person who wears glasses knows the effect of such condensation in going into a warm room from out of doors on a cold day. That the air exhaled contains water may be shown by breathing upon any bright, cold surface.

How a Chill is Produced

The discomfort we feel in a crowded room is largely due to the excess of moisture resulting from the breathing and perspiration of so many persons. The danger of going from a crowded reception or "tea" into the open air is also due to it. Crowded rooms become very warm, the air soon becomes saturated with vapor and cannot take away the perspiration from our bodies. Our clothes thus become moist and the skin tender. When we go into the colder, drier air, clothes and skin suddenly give up their load of moisture. Evaporation absorbs heat; the heat is taken from our bodies and a chill results. There is much to learn concerning the ventilation of rooms for social purposes.

Argon

The air also contains a very small amount of a gas called argon. This was discovered in 1894. It resembles nitrogen so closely that it long escaped detection. Several other gases are present in minute quantities.

COMBUSTION

Very likely a fire must be built in the cook stove. In order that chemical combination may take place, the conditions must be right. The stove is so constructed that a current of air can pass from under the grate through the fire box, and funnel, to the chimney, and we must arrange that this air current shall not be unduly obstructed, for fuel will not burn without oxygen.

Kindling Point

Substances differ greatly as to the ease or difficulty with which they may be made to burn, or in chemical terms, with which they may be made to unite with oxygen. The temperature to which a substance must be heated before it will take fire is called the kindling point. We therefore place light materials, like shavings, pitch-pine chips, or paper on the grate, twisting the paper and arranging all in such a way that oxygen has free access to a large surface; upon this we place small sticks of wood, piling them across each other for the same reason, and on this, in turn, hard wood or coal. The large stick of wood or the coal cannot be kindled with a match, but the paper or shavings can, and these in burning will heat the wood until it takes fire which then will kindle the coal.

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Chemistry of a Match

To kindle the fire, we unthinkingly light a match. The burning of the match repeats the same principle we have described. The match is made by dipping the ends of small sticks of wood into melted sulphur, a substance more easily kindled than wood. When the sulphur is dried, the match is tipped with a preparation of phosphorus. Phosphorus has such a low kindling temperature that friction of the match against any rough surface heats it sufficiently to set it on fire. In burning, this sets fire to the sulphur and this, in turn, kindles the wood. Paraffine now has replaced sulphur.

Products of Combustion

The products (substances formed) of the burning match are oxide of phosphorus, oxide of sulphur, and carbon dioxide and water from the carbon and hydrogen of the wood. As our coal fire burns, we have two different oxides of carbon formed—carbon monoxide composed of one part carbon and one part oxygen, and carbon dioxide having two parts oxygen to one of carbon. The carbon monoxide formed in the lower part of the fire rises through the burning coals, takes up more oxygen at the top of the fire and forms carbon dioxide. The blue flames seen over a hard coal fire are caused by carbon monoxide burning. Carbon dioxide does not burn, since in this form the carbon holds as much oxygen as possible. The drafts and dampers so regulate the supply of oxygen that the fire may burn rapidly or slowly and that the harmful products of combustion may be carried out of the house by way of the chimney.

Carbon Monoxide

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Constant Composition of the Air

It might be thought that with the millions of human beings and animals and countless fires constantly using oxygen and giving off carbon dioxide, that the atmosphere would soon consist of a large proportion of carbon dioxide. Nature has wonderfully provided for this. Carbon dioxide, which is the waste matter of animals, is one of the foods of plants. Thus the trees of the forest and the shrubs and plants of the garden are continually taking in the carbon dioxide and giving out pure oxygen, so that the carbon dioxide is kept at about three or four parts in 10,000 of air.

As has been said, wood consists mainly of the substances, carbon, oxygen, hydrogen, and nitrogen, together with other substances in small amounts. The growing tree has taken these simple substances from the air and earth and stored them up in a complex form as wood.

Elements

The chemist calls the simple substances out of which different things are made, elements. Carbon, oxygen, nitrogen, sulphur, phosphorus, silver, gold, copper, iron, lead, tin, mercury, zinc, aluminum are the chemical elements familiar to most people. When the wood is burned, or *oxidized*, its elements are made into new combinations, but in the burning no substance is *destroyed*. Some of the new products are invisible, it is true, but that they exist may be proved in many ways.

One of the fundamental laws of chemistry is the Law of Conservation of Matter (substance). This may be stated as follows: The weight of all the

products made in a chemical action is exactly equal to the weight of all the substances used. That is, the weight of the dry wood plus the weight of the oxygen required to burn it, equals the combined weight of carbon dioxide, water, and ashes produced. Matter can neither be destroyed nor created — it can only be changed or transformed. Scientists have reason to believe that there is just the same amount of oxygen, nitrogen, sulphur, iron and of all the other elements in the universe at the present moment as there was at the beginning of things.

Conservation of Matter.

A familiar form of nearly pure carbon is charcoal. It is made by heating wood for a time with a very small amount of air. The volatile parts of the wood are driven off, leaving the carbon. The old fashioned method of making charcoal is shown in Fig. 11, where the burning of part of the wood gave the heat necessary for the making of the charcoal. At the present time, most charcoal is made by the destructive distillation of hard wood in iron stills; the products being charcoal, crude wood alcohol, crude acetic acid, together with gas and wood tar, which last are burned to give the heat for the process.

Charcoal

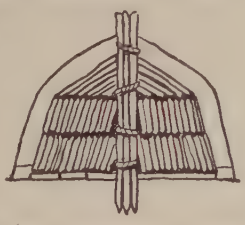


Fig. 11. Charcoal Kiln.

Charcoal is a porous substance and has the power of absorbing into its pores gases and even particles of

coloring matter. A few pieces of charcoal added to the water in which flowers are standing, or plants growing, help to keep the water sweet by absorbing the impurities. Boneblack, a very finely powdered animal charcoal, is used to decolorize liquids. If it is mixed with a dark syrup, for instance, and the mixture violently shaken, the color will be absorbed and filtration will give a nearly colorless syrup.

Coal

Coal is formed in almost every country on the earth, but the United States has the largest amount. It was originally wood and other carbonaceous material, once a part of living organism at a date of perhaps millions of years ago. During these years, the earth's crust has been subjected to slow upheavals and depressions, so that in some places, what was originally at the surface has been covered with thousands of feet of earthy matter, or possibly by the ocean. Under enormous pressure, the plants have been subjected to heat from the earth's interior. This is destructive distillation on the largest scale.

Graphite

In the making of coal if this distillation is complete, a substance called graphite is obtained. Graphite is the black lead used in lead pencils and in stove polish. It is a shiny, black mineral with a slippery feeling and is nearly 100 per cent carbon. If the distillation is less complete, hard coal, called anthracite containing about 90 per cent carbon, results. If still less perfect, soft or bituminous coal, having varying percentages of carbon, is formed.

Where the process goes on under water, peat is found. This is partially formed coal, but little distilled and contains only about 40 per cent carbon. Peat

Besides carbon, these substances are made up of gases composed of carbon and hydrogen, called *hydro-carbons.* These gases give the yellowish and orange flames in a coal fire. Pure carbon does not burn with flame—it merely glows. Anthracite coal contains only from 3 to 4 per cent of volatile matter, but bituminous coal may have 30 to 40 per cent of these hydro-carbon gases.

Coke is made by the destructive distillation of soft coal. Like charcoal, it is chiefly carbon, but contains more mineral matter (ash). The coke obtained as a bi-product in the manufacture of coal gas is rather soft, but when coke is made as the principal product, it is hard and brittle. Coke makes a very hot fire without flame, but does not last as well as hard coal. The ash should be allowed to accumulate in the grate when burning it. Many consider it an improvement over soft coal for household use and it might be used to advantage more than it is. Coke

Graphite is so hard and compact that it cannot be burned. Anthracite ignites with some difficulty and then burns slowly with intense heat.

Bituminous coal ignites readily and burns well when there is sufficient draft. The "coking" variety cakes over on top and the fire must be broken up to allow the air to penetrate the fire. Soft coal should be put on the fire in small amounts as otherwise the hydro- Coking Coal

carbon gases escape unburned and thus much heat value is lost. Smoke is made up of finely divided particles of carbon and is always an indication of incomplete combustion and, therefore, loss.

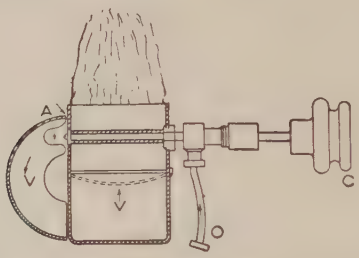


Fig. 12. Burner of a Blue Flame Oil Stove.

Oil from tank (not shown) is forced up O, is vaporized in passing through the straight tube, mixes with air at A, and burns with a blue flame at the top.

Kerosene

Kerosene and gasoline are also important fuels. Gas will be taken up under the subject of light. Petroleum is an oily liquid found in many places in large quantities, particularly in Pennsylvania and Ohio. It is made up almost entirely of compounds of carbon and hydrogen (hydro-carbons).

When the crude petroleum from the Pennsylvania district is purified by distillation and other processes, the main product is kerosene. The lighter and more volatile products are gasoline, naphtha, and benzine —all three having much the same composition. Gasoline is the most volatile. Among the heavier products are various lubricating oils, vaseline, and paraffin.

In order to burn, kerosene must be vaporized. In the new blue flame oil stoves, various devices are em-

ployed to vaporize the oil. In Fig. 12 the oil passes through a tube heated by the flame, where it is changed to vapor which is mixed automatically with air and is then burned. Sometimes an alcohol flame is used to start this process, but the flame of the burning oil itself continues it. A slight pressure of air is maintained in the oil reservoir to give a constant small jet of oil to be vaporized. In other styles of stoves, the oil is fed automatically by gravity to a hollow ring, when it becomes heated to the point that it gives vapor. The vapor mixes with air and burns with a blue flame. Fig. 13.

Blue Flame Oil Stoves

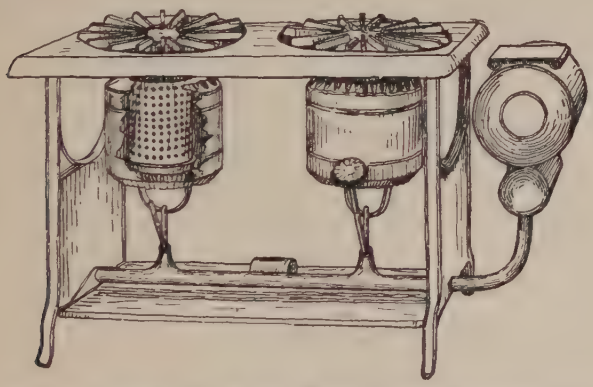


Fig. 13. Blue Flame Oil Stove, Showing Oil Reservoir and Lighting Ring.

Gasoline is burned on much the same principle as kerosene. It vaporizes much more easily and the pressure for the flow of the gasoline is furnished usually by having the tank a few feet above the burner.

Gasoline

Flash Point

The measure of safety of kerosene is the temperature at which it will give off an inflammable gas. This is called the *flash point* and is determined by heating the oil slowly and observing the temperature at which a flash can be produced by applying a lighted taper to the surface of the oil. Below the flash point, there is no danger of explosion from oil. Most states in the United States have a legal flash point, or a fire test, below which standard kerosene cannot be sold. The flash point of good kerosene is 120° F. The *fire test* is the temperature at which the oil will take fire and *burn* when a light is applied. This is about 30° F higher than the flash point. The ordinary temperature of the room is above the flash point of gasoline, naphtha, benzine, etc. In other words, these substances are constantly giving out an inflammable vapor.

Fuel Value

A comparison of the heating value of the various fuels will be of interest. Practical tests of the amount of steam produced in a steam boiler have shown that one cord of ordinary wood is approximately equal to one-half ton of coal; a gallon of oil (or gasoline) is equal to about twelve pounds of coal; 1,000 cubic feet of coal gas is equal to 50 or 60 pounds of coal, or about four and one-half gallons of oil. Hard coal has a little higher fuel value than soft coal, because the combustion is commonly more perfect. Coke is nearly equal to hard coal by weight, but is much more bulky. It is usually sold by measure. A bushel of coke weighs 40 pounds, of anthracite 67 pounds, and of soft

coal 76 pounds. Damp wood is a much poorer fuel than dry wood, because so much heat is absorbed and wasted in changing the water into steam.

The heat given off by a fuel is not the only point to be considered. In the cook stove, but a small portion of the heat given off by the solid fuel can be used for cooking, as most of it is radiated into the room or carried up the chimney. In the gas or oil stove, the flame may be applied exactly where it is wanted, so that the proportion of heat which can be used is much greater. Moreover, the flame can be shut off instantly when wanted no longer and all expense stopped. On the other hand, the range usually serves to heat the water of the hot water system, incinerate garbage, and in winter helps to heat the house.

FOOD

Having the fire well under way the housekeeper turns her attention to the breakfast. A great variety of chemical actions may here be considered. In the first place, why must we "eat to live?"

Why We Must Eat

Wherever there is life, there is chemical change; and as a rule a certain degree of heat is necessary in order that chemical change may occur. Vegetation does not begin in the colder climates until the air becomes warmed by the heat of the spring. When the cold of winter comes upon the land vegetation ceases.

Since many animals live in temperatures in which plants would die, it is evident that they must have some

Combustion in the Body

source of heat in themselves. This is found in the union of the oxygen of the air breathed with carbonaceous matter eaten as food and the formation of carbon dioxide and water, just as in the combustion of wood or coal. Only instead of this union taking place in one spot and so rapidly as to be accompanied by light, as in the case of fire, it takes place slowly and continuously in each living cell. Nevertheless, the chemical reaction seems to be identical.

Vital Temperature

The heat of the human body must be maintained at 98.5° F—the vital temperature—the temperature necessary for the best performance of the normal functions. Any continued variation from this degree of heat indicates disease. Especially important is it that there be no considerable *lowering* of this temperature, for a fall of one degree is dangerous, since in that case the chemical changes necessary to the body cannot be carried out.

Air as Food

The slow combustion or oxidation of the carbon and hydrogen of food cannot take place without an abundance of oxygen; hence the diet of the animal must include fresh air—a point not always considered.

The amount of oxygen taken in by the body daily is equal to the sum of all the other food elements.

Except water, two-thirds of these foods consists of some form of starch or sugar—the socalled *carbohydrates*, in which the hydrogen and oxygen are found in the same proportion as in water.

The power to do *mechanical work* comes from the

combustion of fuel. The body is a living machine capable of doing work, raising weights, pulling loads, and the like. The animal body also requires fuel in order to do such work as thinking, talking, even worrying. For the present, then, we will say that food is necessary, (1) to preserve the vital temperature and (2) to enable the body-machine to do its work. The Body a Machine

Suppose we begin our breakfast with fruit, say, an orange or a banana. Fruits are especially rich in sugars and these are composed of carbon, hydrogen, and oxygen. If sugar is placed upon a stove, it will melt and steam (water) will pass off into the air, leaving the black charcoal (carbon) on the stove. Moreover, sugars burn easily and fiercely. We shall get both heat and energy from our fruit. Within the body it will be changed into water and carbon dioxide. Fruits contain a large percentage of water; but the banana is capable of giving more energy and heat than the orange, because it has much less water and more sugar. Fruit loses in drying a large portion of its water, so that dried fruits contain a larger percentage of food materials than fresh fruits. For instance, raisins are 60 per cent grape sugar. Fruit

Fruits consist of a loose net-work of a woody material holding the soft pulp and this woody fibre, called cellulose, is practically indigestible. Cooking softens this, making cooked fruits easier to digest. Cellulose

SUGARS AND STARCHES.

At breakfast some sugar from the sugar bowl may be added to the fruit. Many people add sugar to the oatmeal or other cereal eaten, although it is often held by teachers of dietetics that this is not a good place to use it, for proper cooking and thorough mastication of the cereal will bring out a rich sweetness due to changes explained later. Country boys know how sweet a morsel is made by chewing raw grains, especially wheat. Possibly a glass of milk is taken at breakfast and this contains another kind of sugar—milk sugar—in about 5 per cent. Coffee and tea are usually sweetened, so that a considerable part of the breakfast may be of this class of foods—a quickly burning material giving heat and energy.

Cane Sugar

There are several different sugars recognized by chemists; these are cane sugar or *sucrose*, grape sugar or *glucose*, milk sugar or *lactose*, and fruit sugar or *levulose*. Cane sugar is obtained from the juices of many plants, notably sugar beets, sugar cane, the palm, and as maple sugar from the rock-maple trees. Molasses and brown sugar are obtained during the manufacture of white sugar from sugar cane. Cane sugar is composed of carbon, hydrogen, and oxygen in the proportion of twelve parts of carbon to eleven parts of water. When sugar is heated it is chemically changed, more or less, according to the degree of heat and the rapidity with which it parts with its water.

Heating it gradually, we obtain first straw colored barley sugar, then brown caramel, and finally black carbon.

Grape Sugar

Grape sugar is found in honey and in all ripe fruits. It consists of carbon, hydrogen, and oxygen in somewhat different proportions from what they occur in cane sugar. It appears on the outside of dried fruits, such as raisins. It is only two-fifths as sweet as cane sugar. Large quantities are manufactured from corn starch.

Milk Sugar

Milk sugar is similar to cane sugar in composition. It is obtained from the whey of milk. It is hard and gritty and not very sweet to taste. When milk sours, it is because this sugar is fermented and changed into lactic acid. The acid causes the milk to curdle.

Fruit Sugar

Fruit sugar or levulose occurs with glucose (grape sugar) in fruits. It is about as sweet as cane sugar but it does not crystallize.

A marked characteristic of all sugars is their solubility and all but the last are crystalline substances, that is, will form crystals.

Starch

At breakfast bread, toast, or some cereal like oatmeal or wheat, usually follows the fruit course. These foods are prepared from grains (seeds) and contain much nutriment in a condensed form. They supply the body with starch and some nitrogenous food. But the body cannot use starch as such. It must be changed into a form of sugar called *starch sugar,* or maltose. While we are following Mr. Glad-

stone's rule and chewing each mouthful of our toast twenty-five times, we will consider what starch is like and how it is made available for use.

Source of Starch

Starch is found in greater or less abundance in all plants and is laid up in large quantities in the seeds of many species. See Fig. 14. Rice is nearly pure starch; wheat and the other cereals contain sixty to seventy per cent of it. Some tubers, such as potatoes, contain it although in less quantity—ten to twenty per cent.

Fig. 14. Starch Much Magnified. a, Potato Starch; b, Corn Starch.

It is formed by means of the living plant-cell and the sun's rays, from the carbon dioxide and water contained in the air and it is the end of the plant-life — the stored energy of the summer. It is prepared and stored by the parent for the food for the young plant until the latter can start its own starch factories.

Starch in its common forms is insoluble in water. It dissolves partially in boiling water, forming a transparent jelly when cooled, as every housekeeper knows. The cellulose which occurs in various forms in the shells and skins of fruits, in their membraneous partitions, and in cell walls, is an allied substance.

DIGESTION

Digestion of Starch

Digestion is primarily synonymous with solution. All solid food materials must become practically soluble before they can pass through the walls of the digestive system. Starch and like materials must be transformed into soluble substances before absorption can take place. Cane-sugar, though soluble, has to undergo chemical change before it can be absorbed. By these changes it is converted into grape and fruit sugars. These and milk sugar are taken directly or with little change into the circulation. To this fact is due a large part of the great nutritive value of the dried fruits, as raisins, dates, and figs, and the advantage of milk-sugar over cane-sugar for children or invalids.

Under certain conditions—weakened digestive power or excess of sugar—cane-sugar may remain so long in the stomach before the change takes place that fermentation sets in and a "sour stomach" results. This is one of the dangers of too much candy.

The chemical transformations of starch and sugar have been very carefully and scientifically studied with reference to brewing and wine-making. Several of the operations concerned necessitate great precision in respect to temperature and length of time, and these operations bear a close resemblance to the process of bread-making by means of yeast.

Starch Conversion

There are two distinct means known to the chemist by which starch is changed to sugar. One is by the

use of acid and heat, which changes the starch into sugar, but can go no farther. The other is by the use of a class of substances called ferments, some of which have the power of changing starch into sugar, and others of changing the sugar into alcohol and carbon dioxide. These ferments are very important in all vegetable and animal life. Some are formed by small plants like yeast, which is often present in the air. Fig. 15.

Ferments

Among the well known ferments is one formed in sprouting grain, which is called diastase or starch converter, and under the influence of warmth, changes the starch into a sugar. The starch first takes up water; then under the influence of the ferment, is changed into maltose, a form of sugar which is easily soluble in water. A similar process is carried on in the preparation of the malted foods on the market.

Fig. 15.
Yeast Highly Magnified.

Conversion in the Body

The same cycle of chemical changes goes on in the human body when starchy substances are taken as food. Such food is moistened with saliva and warmed in the mouth, becoming well mixed through mastication. It thereby becomes impregnated with *ptyalin*, a ferment in the saliva, which can change starch into sugar, as can the diastase of the malt. The mass then passes into the stomach and the change, once begun, goes on. In the intestines the sugar formed is absorbed into the circulatory system and by the life proc-

esses, is oxidized, that is, united with more oxygen and changed finally into carbon dioxide and water, from which it was made by the help of plant life and sun light.

Digestion of Starch

No starch is utilized in the human system as starch. It must undergo transformation before it can be absorbed. Therefore, starchy foods must not be given to children before the secretion of the starch converting ferments has begun, nor to any one in any disease where the normal action of the glands secreting these ferments is interrupted. Whatever starch passes out of the stomach unchanged, meets with a very active converter in the intestinal juice. If grains of starch escape these two agents, they leave the system in the same form as that in which they entered it.

COOKING

Early man, probably, lived much like the beasts, taking his food in a raw state. Civilized man requires much of the raw material to be changed by the action of heat into substances more palatable and already partly digested.

Cooking of Starch

The chemistry of cooking the raw materials is very simple. It is in the mixing of incongruous materials in one dish or one meal that complications arise.

The cooking of starch, as rice, farina, etc., requires little explanation. The starch grains are prepared by the plant to keep during a season of cold or drought and are very close and compact; they need to be

swollen and distended by moisture in order that the chemical change may take place readily. Starch grains may increase to twenty-five times their bulk by absorbing water.

The cooking of the potato and other starch-containing vegetables, although largely a physical or mechanical process is very necessary as a preparation for the chemical actions of digestion; for raw starch has been shown to require a far longer time and more digestive power than cooked starch. Change takes place slowly, even with thorough mastication, unless the starch is swollen and heated, and, in case the intestinal secretion is disturbed, the starch may not become converted at all.

Bread

Our breakfast will undoubtedly contain bread. Bread of some kind has been used by mankind from the first dawn of civilization. During the earlier stages it consisted chiefly of powdered meal and water baked in the sun or on hot stones. This kind of bread had the same characteristics as the modern sea-biscuit, crackers, and hoe cakes, as far as digestibility was concerned. It had great density; it was difficult to masticate; and the starch in it presented but little more surface to the digestive fluids than that in the hard compact grain, the seed of the plant.

Experience must have taught the semi-civilized man that a light porous loaf was more digestible than a dense one. Probably some dough was accidentally left exposed; yeast plants settled upon it from the air;

fermentation set in, and the possibility of porous bread was thus suggested.

Ideal Bread

A light, spongy, crisp bread with a sweet, pleasant taste, is not only aesthetically but chemically considered the best form in which starch can be presented to the digestive organs. The porous condition is desired in order that as large a surface as possible may be presented to the action of the chemical converter, the ptyalin of the saliva, and later to other digestive ferments. There is also better aeration during the process of mastication.

Leaven or Yeast

Very early in the history of the human race, leavened bread seems to have been used. This was made by allowing flour and water to stand in a warm place until fermentation had well set in. A portion of this dough was used to start the process anew in fresh portions of flour and water. This kind of bread had to be made with great care, for germs different from yeast might get in, forming lactic acid—the acid of sour milk—and other substances unpleasant to the taste and harmful to the digestion.

A sponge made from perfectly pure yeast and kept pure may stand for a long time after it is ready for the oven and still show no signs of sourness.

On account of the disagreeable taste of leaven and because of the possibility that the dough might reach the stage of putrid fermentation, chemists and physicians sought for some other means of rendering the bread light and porous. The search began almost as

soon as chemistry was worthy the name of a science, and one of the early patents bears the date 1873. Much time and thought have been devoted to the perfecting of unfermented bread; but since the process of beer-making has been universally introduced, yeast has been readily obtained, and is an effectual means of giving to the bread a porous character and a pleasant taste. Since the chemistry of the yeast fermentation has been better understood, a change of opinions has come about, and nearly all scientific and medical men now recommend fermented bread, if well baked.

Chemistry of Bread-Making

The chemical reactions concerned in bread-making are similar to those in beer-making. To the flour and warmed water is added yeast, a microscopic plant, capable of causing the alcoholic fermentation. The yeast begins to act at once, but slowly; more rapidly if sugar has been added and the dough is a semi-fluid. Without the addition of sugar no change is evident to the eye for some hours, as the fermentation of starch to sugar by the diastase present gives no gaseous products. The sugar is decomposed by the yeast plant into alcohol and the gas, carbon dioxide; the latter product makes itself known by the swelling of the whole mass and the bubbles which appear on the surface.

It is the carbon dioxide, which causes the sponge-like condition of the loaf by reason of the peculiar tenacity of the gluten, one of the constituents of wheat. It is a well-known fact that no other kind of grain will

make so light a bread as wheat. It is the right proportion of gluten (a nitrogenous substance to be considered later) which enables the light loaf to be made of wheat flour.

The production of carbon dioxide is the end of the *chemical* process. The rest is purely mechanical.

Object of Baking

The baking of the loaf has for its object to kill the ferment, to heat the starch sufficiently to render it easily soluble, to expand the carbon dioxide and drive off the alcohol, to stiffen the gluten, and to make chemical changes which shall give a pleasant flavor to the crust. The oven must be hot enough to raise the temperature of the *inside* of the loaf to 212° F, or the bacteria will not all be killed. A pound loaf, four inches by four inches by nine inches long, may be baked three-quarters of an hour in an oven where the temperature is 400° F, or for an hour and a half, when the temperature during the time does not rise above 350° F. Quick baking gives a white loaf, because the starch has undergone but little change. The long, slow baking gives a yellow tint, with the desirable nutty flavor, and crisp crust. Different flavors in bread are supposed to be caused by the different varieties of yeast used or by bacteria, which are present in all doughs, as ordinarily prepared.

The Crust

The brown coloration of the crust, which gives a peculiar flavor to the loaf, is caused by the formation of substances analogous to dextrine and caramel, due to the high heat to which the starch is subjected.

One hundred pounds of flour are said to make from 126 to 150 pounds of bread. This increase of weight is due to the incorporation of water, possibly by a chemical union, as the water does not dry out of a loaf, as it does out of a sponge. The bread seems moist when first taken from the oven, and dry after standing some hours, but the weight will be found to be nearly the same. It is this probable chemical change which makes the difference, to delicate stomachs, between fresh bread and stale. A thick loaf is best when eaten after it is twenty-four hours old, although it is said to be "done" when ten hours have passed. Thin biscuit do not show the same ill effects when eaten hot.

The bread must be well baked in any case, in order that the process of fermentation may be stopped. If this be stopped and the mastication be thorough, so that the bread when swallowed is in finely divided portions instead of in a mass or ball, the digestibility of fresh and stale bread is about the same.

Water Bread

The expansion of water or ice into more than seventeen hundred times its volume of steam is sometimes taken advantage of in making snow-bread, water-gems, etc. It plays a part in the lightening of pastry and crackers.

Air, at 70 degrees, doubles its volume at a temperature of 560 degrees F, so that if air is entangled in a mass of dough, it gives a certain lightness when the whole is baked. This is the cause of the sponginess of cakes made with eggs. The viscous albumen or

"white of egg" catches the air and holds it, even when it is expanded, unless the oven is too hot, when the sudden expansion is liable to burst the bubbles and the cake falls.

FATS

If cream instead of milk is used on the cereal or in the coffee, this with the butter on the bread, will add a considerable amount of another important food, fat. Fats form a large class of food stuffs which include the animal fats like cream, butter, suet, lard, cod liver oil and tallow, and vegetable fats like olive and cotton-seed oils, etc. Within the animal body all fats are liquids, being held in little cells which make up the fatty tissue.

Digestion of Fats

The digestion of fats is probably something like a process of soap making. With the intestinal fluids, the bile especially, the fats form an emulsion in which the globules are finely divided, and in some way are rendered capable of passing through the membranes into the circulatory system. The change, if any, does not destroy the properties of the fatty matters.

If we define cooking as the application of heat, then whatever we do to fats in the line of cooking is liable to hinder rather than help digestibility.

Cooking of Fats

Fats may be heated to a temperature far above that of boiling water without showing any change; but there comes a point, different for each fat, where reactions take place, the products of which irritate the mucous membranes and therefore interfere with diges-

tion. It is the volatile products of such decomposition which cause the familiar action upon the eyes and throat during the process of frying, and also, the tell-tale odors throughout the house. The indigestibility of fatty foods, or foods cooked in fat, is due to these harmful substances produced by too high temperature.

Composition of Fats

Many fats are solid at ordinary temperatures, while others are always liquids, but all fatty materials have a similar composition. When pure they contain only carbon, hydrogen, and oxygen. They differ from starch and sugar in the proportion of oxygen to the carbon and hydrogen, there being very little oxygen relatively in fats, hence more must be taken from the air for their combustion. If persons eat much fat they must have more fresh air to burn it. A person confined to the house needs to be careful what fats, and how much, are taken.

Heat from Fats

One pound of starch requires one and two-tenths pounds of oxygen, while one pound of suet requires about three pounds of oxygen for perfect combustion. This combustion of oxygen with the large amount of hydrogen, as well as with the carbon, results in a greater quantity of heat from fat, pound for pound, than can be obtained from starch or sugar. Experiments indicate that the fats yield more than twice as much heat as the carbohydrates; hence people in Arctic regions use large amounts of fat and everywhere the diet of winter may safely contain more fat than that of summer.

Food a Source of Energy

Both fats and carbohydrates are the sources of the energy or work done by the body as well as the heat to keep up the vital temperature and they must be increased in proportion as the mechanical work of the body increases. A man breaking stone needs more fat or starch than the student. If a quantity is taken at any one time greater than the body needs for immediate work, the surplus will be deposited as fat, and this will be drawn in case of a lack in the future supply of either; it is like a bank account.

NITROGENOUS FOODS

The animal body is more than a machine. It requires fuel to enable it not only to work but also to live, even without working. A part of the food eaten must go to maintain the body, for while the inanimate machine is sent periodically to the repair-shop, the living machine must do its own repairing, day by day and minute by minute.

The adult animal lives, repairs waste, and does work; while the young animal does all these and more —it grows. For growth and repairs something else is needed beside starch and fat.

Nitrogen Necessary

The muscles are the instruments of motion, and they must be nourished in order that they may have power. The nourishment is carried to them by the blood in which, as well as in muscular tissue, there is found a food element which we have not heretofore considered, namely, nitrogen. It has been proved that the use of the muscles and the brain sets free certain

nitrogenous compounds which pass out of the system as such, and this loss must be supplied by the use of some kind of food which contains nitrogen. Starch and fat do not contain this element; therefore they cannot furnish it to the blood.

The American breakfast will probably include meat, fish, or eggs. These are examples of the nitrogenous food-stuffs. Nitrogenous food compounds are sometimes classed together under the name of proteins. These may be divided into proteids, gelatinoids, and extractives.

Proteids

The proteids all resemble albumin, which is found nearly pure in the white of an egg. These in some form are never absent from animal and vegetable organisms. They are most abundant in animal flesh and in the blood. Other common articles of diet belonging to this group in addition to albumin, are the curd of milk (casein), the lean of animal flesh and fish and gluten of wheat, and the legumin of peas and beans. The proteids are the most important nitrogenous food materials. They build up and repair the muscles, tendons, cartilage, bones, and skin and supply the albumin of the blood and other fluids of the body.

Gelatinoids

The animal skeleton—horns, bones, cartilage, connective tissues, etc.—contains nitrogenous compounds which are converted by boiling into substances that form with water a jelly-like mass. These are known as the gelatinoids and are so named because of their resemblance to gelatin. Although somewhat

similar to the proteids in composition they are not thought to be true flesh formers. However, they do help out the proteids in some unknown way.

Collagen

The chief constituent of the connective tissues of meats is *collagen*. This is insoluble in cold water, but in hot water becomes soluble and yields gelatin. Collagen swells when heated and when treated with dilute acids. Steak increases in bulk when placed over the coals, and tough meat is rendered tender by soaking in vinegar. Meat a few days old is tough, for the collagen is dry and hard. In time it becomes softened by acids which are secreted by bacteria either in or on the meat; the meat thus becomes tender and easily masticated. Tannic acid has the opposite effect upon collagen, hardening and shrinking it. This effect is taken advantage of in tanning, and is the disadvantage of *boiled* tea as a beverage, since tea always contains a little of this tannic acid when freshly made and much more if the tea is boiled.

Extractives

The last class of nitrogenous compounds are the extractives, so called because they are readily extracted by water from meat where they principally occur. The proteins of this class are thought to have little value as food, but they give the flavor to meats, etc., and are therefore of great importance. They are stimulants, somewhat of the nature of caffein of coffee and the thein of tea.

COOKING OF NITROGENOUS FOOD-STUFFS.

Cooking should render nitrogenous food more soluble because here, as in every case, digestibility means solubility. Egg albumin is soluble in cold water, but coagulates at about 160° F. At this point it is tender, jelly-like, and easily digested, while at a higher temperature it becomes tough, hard and dissolves with difficulty. Therefore, when the white of egg (albumin), the curd of milk (casein), or the gluten of wheat are hardened by heat, a much longer time is required to effect solution.

Albumin

As previously stated, egg albumin is tender and jelly-like when heated from 160° F to 180° F. This fact should never be forgotten in the cooking of eggs. Raw eggs are easily digested and are rich in nutriment; when heated just enough to coagulate the albumin or "the white," their digestibility is not materially lessened; but when *boiled,* the albumin is rendered much less soluble.

In frying eggs, the fat often reaches a temperature of 300° or over—far above that at which the albumin becomes tough, hard, and well-nigh insoluble.

There is much albumin in the blood, therefore the juices of meat extracted in cold water form a weak albuminous solution. If this be heated to the right temperature the albumin is coagulated and forms the "scum" which many a cook skims off and throws away. In doing this she wastes a portion of the nutriment.

Gluten

Experiments on the digestibility of gluten have proved that a high temperature largely decreases its solubility. Subjected to artificial digestion for the same length of time, nearly two and one-half times as much nitrogen was dissolved from the raw gluten as from that which had been baked.

When gluten is combined with starch, as in the cereals, the difficulties of correct cooking are many, for the heat which increases the digestibility of the starch decreases that of the gluten.

Experiment.- The gluten in wheat flour may be obtained as follows: Place half a cupful of flour in a muslin bag and knead under water. The starch will work out through the bag. After a time all the starch may be so separated. A brown, elastic, stringy mass remains in the muslin. This is gluten, the nitrogenous part of the flour.

Casein

The same principle of cooking applies to casein of milk, although to a less extent. There seems to be no doubt that boiling decreases its solubility, and consequently, its digestibility for persons of delicate digestive power.

Meat

The nitrogenous substances of meat consist of soluble albumin, chiefly in the blood and juices, the albuminoids of the fibres, the gelatinoids of the connecting tissues, and the extractives. The cooking should soften and loosen the connective tissue, so that the little bundle of fibre which contains the nutriment may fall apart easily when brought in contact with the

teeth. Any process which toughens and hardens the meat should be avoided.

When it is desired to retain the juices within the meat or fish, it should be placed in boiling water so that the albumin of the surface may be hardened and prevent the escape of the albumin of the interior. The temperature should then be lowered and kept between 160 and 180 degrees during the time needed for the complete breaking down of the connective tissues.

Broth and Soup

When the nutriment is to be used in broths, stews, or soups, the meat should be placed in cold water, heating very slowly and the temperature not allowed to rise above 180° F until the extraction is complete. The extracted meat still retains the greater part of its original proteid substances. It is tasteless and uninviting, but when combined with vegetables and flavoring materials may be made into a palatable and nutritious food.

Effect of Temperature on Meat

Experiment. To show the effect of water at different temperatures upon raw meat, place a bit of lean meat about as large as the finger in a glass of cold water and let it stand an hour. The water becomes red, and the meat grows white. Pour off this water and boil it. A scum rises to the surface. The albumin dissolved has been rendered insoluble by heat.

Put a bit of raw meat into boiling water, and boil it hard several minutes. The meat is toughened by the process. The outside of the meat is hardened first, and very little of the nutriment dissolves in the water.

Put the meat into cold water and bring the temperature slowly to the boiling point; then allow it to simmer gently for some time. The meat is tender, and some of the nutriment is in the water. This is the method employed in making a stew. A little fat which is always present even between the fibre of the lean meat will be melted out and rise to the top of the water.

Digestion of Proteids

We have seen that the ferment in the saliva changed the starch into a sugar. The ferment in the gastric juice, pepsin, with the help of an acid (principally hydrochloric acid) changes the albuminoids into peptones in the stomach. This change is completed in the intestines. The peptones are soluble in water and are absorbed into the blood.

SUMMARY OF THE EFFECTS OF COOKING

The object of all cooking is to make the food-stuffs more palatable or more digestible, or both combined. In general, the starchy foods are rendered more digestible by cooking; the albuminous and fatty foods less digestible. The appetite of civilized man craves and custom encourages the putting together of raw materials of such diverse chemical composition that the processes of cooking are also made complex.

Bread—the staff of life—requires a high degree of heat to kill the plant-life, and long baking to prepare the starch for solution; while, by the same process, the gluten is made less soluble. Fats, alone, are easily digested, but in the ordinary method of frying, they

not only may become decomposed themselves, and therefore injurious; but they also prevent the necessary action of heat, or of the digestive ferments upon the starchy materials with which the fats are mixed.

The effects of cooking upon the solubility of the three important food-principles may be broadly stated thus:

Effect on Solubility

Starchy foods are made more soluble by long cooking at moderate temperatures or by heat high enough to change a portion of the starch to dextrine, as in the brown crust of bread.

Nitrogenous foods. The animal and vegetable albumins are made less soluble by heat; the gelatinoids more soluble.

Fats are readily absorbed in their natural condition, but are decomposed at very high temperatures and their products become irritants.

MINERAL MATTER

The remaining ingredient of the food of our breakfast to be considered is the mineral matter which constitutes the ash when food-products are burned. There is only 5 or 6 per cent of mineral elements in our bodies, but these materials are necessary to life and health. They are found chiefly in the bones and teeth, but are present also in the flesh, blood, and other fluids. Phosphate of calcium forms the principal mineral part of the bones.

Common Salt

The food we eat contains a small amount of mineral matter which forms the ashes when food is burned.

This mineral matter gives the body the mineral salts which it needs; but in addition to this, most people desire and eat a considerable quantity of common salt every day. The amount eaten is far in excess of the sodium and chlorine the body requires, though sodium is an important constituent of many of the fluids of the body, and chlorine is found in hydrochloric acid of the gastric juice, the digestive fluid of the stomach. A great diversity of opinion exists as to the desirability of much salt in the diet, but the balance of evidence indicates that a liberal amount of salt is not harmful, but rather beneficial.

Experiment. To show the mineral part of bones, place a moderate sized bone on a hot coal fire for half an hour or longer.

To show the gelatinoids of bones, place a small bone in a shallow dish and cover with strong vinegar or weak hydrochloric acid (muriatic acid) and let stand over night or longer. The acid will dissolve out the phosphate of calcium leaving the animal matter.

Flavor Production

Coffee, an important part of the breakfast to most people, introduces an important feature of the chemistry of cooking—the production of the proper flavor. The chemical changes involved are too subtile for explanation here—indeed many are not understood. The change in the coffee berry by roasting is a familiar illustration. The heat of the fire causes the breaking up of a substance existing in the berry, and the formation of several new ones. If the heat is not sufficient,

the right odor will not be given; if it is too great, the aroma will be dissipated into the air, or the compound will be destroyed.

Broiling steak is another illustration—a few seconds too long, a few degrees too hot, and the delicate morsel becomes an irritating mass. The chemistry of flavor-producing is the application of heat to the food material in such a way as to bring about the right changes and *only* these. Flavors in addition to the pleasure they give to eating have the advantage of stimulating the flow of digestive fluids and making digestion more easy.

DECAY

The clearing away of the breakfast introduces to the housekeeper two important problems:—(1) the preservation of the remaining food from decay; (2) the proper cleaning of the articles used during the meal and its preparation.

Decay is caused by minute vegetable organisms known as moulds and bacteria. Both are present in the air either as the plants themselves or as their spores, the reproductive cells, ready to grow whenever they fall upon suitable soil. When these grow upon animal or vegetable substances, a variety of new compounds are formed, many of them taking oxygen from the air, so that finally the carbon becomes carbon dioxide, the hydrogen is oxydized to form water, and the other elements in their turn also become oxides, so that the decaying substance is utterly destroyed and

new substances made in its place. When organic substances are protected from the action of these living plants, decay will not ensue.

Decay Not Caused by Oxygen Alone

The old idea was that oxygen caused decay, but many experiments disprove this. Oxygen alone does not produce this result, but oxygen with "germs" will do so. These "germs" develop much more slowly in the cold, so that food is placed in the refrigerator or in a cool place and away from the dust.

The problems introduced by these living plants, their life history and their work, as well as the methods of prevention and care against their ravages, belong rather to household bacteriology than to chemistry. We are ready therefore to pass on to our next problem, that of cleaning.

TEST QUESTIONS

The following questions constitute the "written recitation" which the regular members of the A. S. H. E. answer in writing and send in for the correction and comment of the instructor. They are intended to emphasize and fix in the memory the most important points in the lesson.

CHEMISTRY OF THE HOUSEHOLD.

PART I.

Read Carefully. Place your name and address on the first sheet of the test. Use a light grade of paper and write on one side of the sheet only. *Do not copy answers from the lesson paper.* Use your own words, so that your instructor may know that you understand the subject. Read the lesson paper a number of times before attempting to answer the questions.

1. What do you understand a "chemical element" to be? Name all that you have ever seen.
2. What is a "saturated solution?"
   Name the substances usually found in the house which are soluble in water.
3. What causes atmospheric pressure? Explain some effects of it.
4. Why must the diet of animals include fresh air?
5. Explain the effect of cooking on starch. (b) On fats. (c) On proteids.
6. What are the products of combustion in burning coal or wood?
7. What is meant by "conservation of matter?"
8. How can the boiling point of water be raised? How may it be lowered?

9. What is meant when it is said that a chemical substance always has the same composition?
10. What is "latent heat?"
11. What can you say of the composition of meat?
12. Explain the physical and chemical changes which starch must undergo before it is absorbed into the circulation.
13. What can you say of the chemistry of bread-making?
14. Why is distilled water pure?
15. Explain the composition of water.
16. Describe the chemistry of a sulphur match.
17. How is charcoal prepared? How is coke made?
18. Why does the proportion of carbon dioxide in the atmosphere not increase?
19. In what different ways is food used in the body?
20. Do you understand all parts of this lesson paper? If not, what part is not clear?

NOTE.—After completing the test sign your full name.

ROGERS BUILDING, MASSACHUSETTS INSTITUTE OF TECHNOLOGY, BOSTON

CHEMISTRY OF THE HOUSEHOLD

A Day's Chemistry

PART II.

CLEANING

The cleaning of the dishes, silver, cutlery, and linen introduces a great variety of chemical problems. The subject of the chemistry of cleaning may well include with the daily task of dishwashing, the equally important ones of house cleaning and laundry work.

The various processes of housework give rise to many volatile substances, such as the vapor of water or fat. If not carried out of the house in their vaporous state these cool and settle upon all exposed surfaces, whether walls, furniture, or fabrics. This thin film entangles and holds the dust, clouding and soiling with a layer more or less visible everything within the house. The fires and lights give out smoky deposits of incomplete combustion. The dishes are soiled with waste from all kinds of foods—starch, grease, albumin, milk, gums, or gelatines and the juices of fruits.

Dust *alone* might be removed from most surfaces with a damp or even with a dry cloth, or from fabrics by vigorous shaking or brushing; but usually the greasy or sugary deposits must first be broken up and the dust thus set free. This must be accomplished without harm to the material which is dirty.

Cleaning, then, involves two processes: (1) the greasy or gummy film must be broken up, that the entangled dust and dirt may be set free; (2) the dust must be removed by mechanical means.

We will have occasion to use alkalis for cleaning and acids for removing stains and it will be well to consider what is meant by the terms, acid, alkali, and salt.

An Acid

An acid is a substance with an acid or sour taste and having the property of changing certain vegetable colors. A substance much used in testing for acids is *litmus*, a kind of fungus, giving a blue solution in water. Paper soaked in litmus solution and dried is known as test paper or litmus paper. It can be bought at any druggist's. This paper is turned red by the presence of any acid, even in the most minute quantity. An acid will cause effervescence with a carbonate like cooking soda or washing soda.

An Alkali

An alkali is a substance often having a soapy taste, a slippery feeling if strong, and the property of turning red litmus, blue.

Alkalies will neutralize the effects of acids. If an acid be added very carefully to an alkaline solution, there comes a point where the mixture will change the color of litmus in *neither* direction. The solution is neither acid nor alkaline, and is said to be *neutral*. If we make a weak solution of the acid sold at the drug stores as muriatic acid, and add to this very carefully a weak solution of caustic soda, until the solution is neutral, we shall find that the neutral solution

will taste like table salt. In fact, we have made common salt in this way.

A chemical salt is a substance obtained by neutralizing an acid with an alkali or otherwise—a substance that is usually neutral and will turn the color of neither red nor blue litmus paper. **A Salt**

All acids contain the element hydrogen, which can often be driven out and replaced by a metal placed in the acid. If we drop a bit of zinc into some muriatic acid, tiny bubbles of hydrogen begin to escape. The zinc joins the remainder of the acid, making a new substance. This new substance is the metallic salt, called muriate (or chloride) of zinc. Muriatic acid is also called hydrochloric acid. Thus a salt results from neutralizing an acid with a metal. If oxide of zinc, a white powder, has been used in place of the metal, the same salt, chloride of zinc, would have been made; but no hydrogen gas would have come off, for the hydrogen of the acid would unite with oxygen of the oxide and form water.

Grease or fats, called oils when liquid at ordinary temperature, are chemical compounds made of carbon, oxygen, and hydrogen combined in many different ways, but all contain an ingredient of an acid nature known to the chemist as a fatty acid. The fatty acid base is combined with glycerine in the common fats. **Fats and Oils**

Strong alkaline substances will break up fats into their parts and combine with the fatty acid, thus making soap.

Alkali Metals

The elements which form strong alkalis are the "alkali metals." The common elements of this group are sodium and potassium. There is also ammonium which is not an element, but a combination of nitrogen and hydrogen; it acts, however, like an alkali metal.

When an element unites with water in a certain way it is called a hydrate or hydroxide. The hydrate of ammonium—aqua ammonia or ammonia—is known as the "Volatile alkali" because it evaporates so easily. It is valuable for use in all cleansing operations—in the kitchen, the laundry, the bath, in the washing of delicate fabrics, and in other cases where its property of evaporation, without leaving any residue to attack the fabric or to absorb anything from the air, is invaluable.

Caustic Soda and Caustic Potash

The hydrates of potassium and sodium are called caustic potash and caustic soda, respectively, or the caustic alkalis or "lyes" because they "burn" animal tissues. These combine readily with fats to form compounds which we call soaps.

Most of the fats are soluble in turpentine, ether, chloroform, naphtha, or kerosene, and somewhat in alcohol. That is, the fats are dissolved unchanged, just as salt is taken up by water. These form solvents for greases more or less valuable according to conditions.

If the housekeeper's problem were the simple one of removing the grease alone, she would solve it by the free use of one of the solvents or by some of the strong

alkalis. This is what the painter does when he is called to repaint or to refinish; but the housewife wishes to preserve the finish or the fabric while she removes the dirt. She must, then, choose those materials which will dissolve or unite with the grease without injury to the article cleaned.

Soap

Soap is by all odds the safest and most useful cleaning agent. It is made from most of the common animal and vegetable fats and oils, as tallow, suet, lard, cotton seed oil and cocoanut oil, chemically combined with caustic soda or caustic potash. Castile soap is supposed to be made from olive oil. Rosin soap forms a part of all common yellow soap. It lessens the cost and makes a good soap for rough work. Silicate of soda is sometimes added to cheap soaps. It has some cleansing action, but must be regarded as an adulterant.

Good soaps are nearly neutral substances because the alkali has been neutralized by the fatty acid. The coarser grades may contain more or less free alkali. All soaps are slightly decomposed when dissolved in water. The freed fatty acid produces the milkiness seen when a cake of soap is placed in perfectly pure water.

Action of Soap

The cleaning action of soaps consists chiefly in forming emulsions with oily or greasy substances. Cream is an example of a very perfect emulsion. Its fat is in the shape of very finely divided globules and because of the whey which surrounds them, the cream can be mixed with a very large quantity of water and

show no sign of greasiness. When the whey is separated as in churning, the globules of fat come together and butter is formed. An emulsion is not a true solution, for the particles of fat can be separated by proper means from the liquid.

The soap makes an emulsion with the oily or greasy substances holding the dirt, so that both may be washed away by the water. A certain proportion of free alkali in soap helps the action, but it has a corrosive effect on many materials. Soap will form emulsions with many other materials besides fats and oils; so while water is a very general solvent, soap and water will take up many additional substances.

Kinds of Soap

The housekeeper may be familiar with two kinds of soap: hard soaps and soft soaps. Caustic soda makes the hard soaps and caustic potash makes the soft soaps.

Caustic potash is derived from wood ashes and a few generations ago soft soap was the only laundry soap used. Wood ashes were plenty when wood fires were universal. Soda-ash was at that time derived from sea weeds, and therefore uncommon inland. Early in the century a French manufacturer, Leblanc, discovered a process of making soda-ash from sodium chloride or common salt. This quite reversed the condition of the two alkalis, for now soda-ash is much more common, and the manufacture of soap on a large scale really began then. Soda-ash is now the cheapest form of alkali. Caustic soda is made from soda-ash.

Soda-Ash

The terms, soda-ash, and pot-ash have been used; these substances in chemical terms are respectively the carbonate of sodium and the carbonate of potassium. They are chemical compounds made up of carbonic acid and two metals—sodium and potassium. When the carbon dioxide, which we have seen is formed by the combustion of carbon, is added to water, carbonic acid results. This is a very weak acid and when it is combined with the very strongly alkaline elements, sodium or potassium, the result is an alkaline substance. Soda-ash and potash (sometimes called pearl-ash) are called alkalis, but they are not nearly so powerful as the hydrates of sodium and potassium which are commonly called caustic soda and caustic potash.

Washing Soda

When soda-ash, which is a white powder, is dissolved in hot water and the solution is cooled, crystals of the common washing soda are formed. This substance is also called "sal soda" and "soda crystals." The crystals contain about 65 per cent of water and when exposed to the air, lose some of this water and crumble to the white powder, soda-ash. The powder is, therefore, stronger than the original crystals.

Washing soda should never be used in a solid form, but should be dissolved in a separate dish, and the solution used with judgment. A satisfactory amount is about two ounces of the dry soda to a large tub of water, and well dissolved before the clothes are put in. Nearly all of the "washing compounds" on the market

depend upon the washing soda for their efficiency, and sometimes they contain nothing else.

Borax

Borax is a useful alkali, milder than washing soda, but effective as a cleaner, disinfectant, and bleacher. It is more expensive than either of the others described, and because of its weaker alkaline action, more of it must be used to produce a given result. It is much less irritating to the skin and less injurious to fabrics than soda, so for some uses its additional cost may be justified. Caustic potash or "lye" is too strong an alkali to use on fabrics, but is valuable to put down the kitchen sink drain to free it from grease. The soap made in the drain will be washed out by water. Solid washing soda may be used for the same purpose.

Hard Water

In the laundry the composition of water is important. Water for domestic use is either hard or soft, according as it contains a greater or less quantity of certain soluble salts—usually compounds of lime or magnesia, which have been taken up by the water while passing through the soil.

Temporary Hardness

When the hardness is caused by calcium carbonate (carbonate of *lime*) it is called "temporary" hardness, because it may be overcome by boiling. The excess of carbon dioxide is driven off and the carbonate of lime separates out. The same separation is accomplished by the addition of sal soda, borax, or ammonia.

Permanent Hardness

When the hardness is due to the sulphates and chlorides of magnesia or lime, it cannot be removed

by boiling. It is then known as "permanent" hardness. Public water supplies are sometimes softened before delivery to the consumer by the addition of slaked lime, which absorbs the carbon dioxide, and the previously dissolved carbonate separates out.

Soft water is needed in laundry work both for cleanness and economy, and water not naturally soft should be softened by boiling or by the addition of the before mentioned substances.

Soap and Hard Water

When soap is added to the hard water, it is decomposed by the water, and the new compound formed by the union of the lime and magnesia with the fatty acid of the soap is insoluble, and therefore settles upon any article with which it comes in contact. Until all the lime has been taken out, there will be no action between the soap and the dirt. Therefore, large quantities of soap must be wasted. It has been estimated that each grain of carbonate of lime per gallon causes an increased expenditure of two ounces of soap per 100 gallons, and that the increased expense for soap in a household of five persons where such hard water is used might amount to five or ten dollars yearly.

This "lime soap," although insoluble in water, will dissolve readily in kerosene or naphtha, for which reason, kerosene will be found very effective for cleaning bowls or the bath tub when the surface has become coated from the use of hard water and soap.

Cooking with Hard Water

Hard waters produce certain undesirable effects in cooking processes. The cooking of beans and similar

vegetables should soften the cellulose and break up the compact grains of starch. It is difficult to cook vegetables in hard water, for the legumin of the vegetable forms an insoluble compound with the lime or magnesia of the water, and the cellulose is softened with great difficulty. Hard water does not readily extract the flavor from tea and coffee, and therefore much more of either must be used to get the desired strength.

Dish Washing

During this discussion of cleansing agents, let us hope that the breakfast dishes have been soaking in water, after having carefully scraped or "scrapped" so as to save soap in washing and to keep the water as clean as possible. Plenty of hot water and soap with clean, dry towels is the secret of quick and easy work. If the hard water is used, it may be softened for the soap is doing no good unless there is a strong suds.

To save the appearance of the hands, use a good white soap, free from alkali, and soften the water with borax.

Glass, silver ware, china and kitchen ware take their turn. All should be rinsed in hot water to remove the soap and heat the dishes so that they will drain nearly dry and thus make wiping easy. In the dish washing machine used in large hotels and restaurants, the dishes are simply washed with soapy water and rinsed in very hot water while in such a position that

they drain perfectly. They dry completely and require no wiping. Fig. 16.

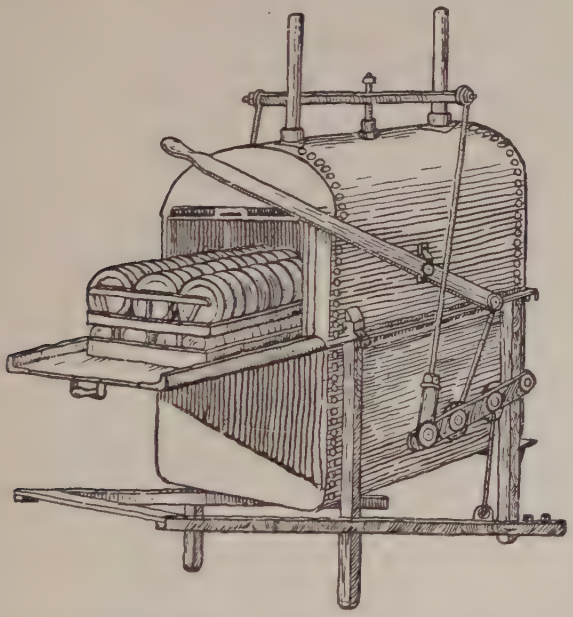


Fig. 16. Dish Washing Machine Used in Large Hotels and Restaurants.

Experiment. Wash a plate and dip it in very hot water, then place it so that all parts will drain. Observe if it dries completely. See if you can wash the dishes in this manner with very little wiping and if time would thus be saved.

CHEMISTRY OF THE LAUNDRY

If the morning happens to be Monday, the washing is probably in progress in the average American family. The mistress should understand the chemical principles involved and every detail of the work, in order that the best results may be secured, and that the clothes may not be harmed.

Structure of Fibres

The fibres of cotton, silk, and wool vary greatly in their structure and a knowledge of this structure as shown under the microscope, may guide to proper methods of treatment. Fig. 17.

Cotton

The fibres of cotton, though tubular, become much flattened during the process of manufacture, and under the microscope, show a characteristic twist, with the ends gradually tapering to a point. It is this twist, which makes them capable of being made into a firm, hard thread.

Wool

The wool fibre, like human hair, is marked by transverse divisions, and these divisions are serrated. These teeth become curled, knotted or tangled together by rubbing, by very hot water, or by strong alkalies. This causes shrinking, which should be prevented. When the two fibres are mixed, there is less opportunity for the little teeth to become entangled and therefore there is less shrinkage.

Linen

Linen fibres are much like cotton, with slight notches or joints along the walls. These notches serve to hold the fibres closely together, and enable them to be felted to form paper. Linen, then, will shrink, though

WASHING DAY

AN ELECTRIC LAUNDRY.
Electric Heated Dry Room with Electric Fan; Electric Stove; Electrically Driven Washing Machine and Wringer; Electric Irons.

not so much as wool, for the fibres are more wiry and the teeth much shorter.

Silk fibres are perfectly smooth and when rubbed, simply slide over each other. This produces a slight shrinkage in the width of woven fabrics. Silk

Cotton and wool differ greatly in their resistance to the treatment of chemicals. Cotton is very little affected by a solution of the alkalies, when the cloth is well rinsed. If the alkali is not removed completely, however, it becomes very concentrated when the cloth dries, and as it generally acts for a long time, the fibre may be weakened or "tendered."

Fig. 17. Textile Fibres Much Magnified.
a, Wool; b, Mohair; C, Cotton; d, Silk; e, Linen.

Cold dilute solutions of the acids have no very great effect on cotton, provided always that they are completely washed out. Strong or hot solutions of acids have a very decided deleterious action, and even a very minute quantity of acid *dried* on the goods tenders the fibre badly. Chemical Action on Fibres

Wool resists the acids well, but is much harmed by the action of the alkalies. A warm solution of caustic soda or caustic potash will dissolve wool quickly and completely. The carbonates. like washing soda,

have not such a decided effect, but they make the wool harsh and less flexible.

Linen resembles cotton and silk is much like wool in the resistance to chemical action, but the linen is more affected by the alkalies than cotton and silk is more acted on by acids than wool.

Fig. 18. Sections of Ordinary and Mercerized Cotton Fibres.

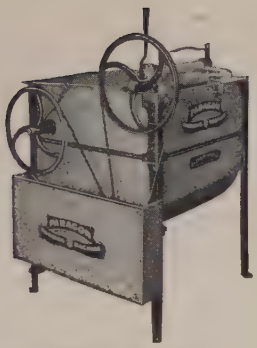
Mercerization

That cotton fibre is not seriously affected by alkalies is shown by the process of mercerization. In this process, patented by Mercer in 1852, the cotton threads are treated with a strong solution of caustic soda while under tension. The fibres lose their twisted and hollow shape and become more rod-like and nearly solid, as shown in Fig. 18. The threads have a tendency to shrink considerably, but are prevented by the tension. This and the method of manipulation gives the mercerized fabric the characteristic gloss somewhat resembling silk.

Soaking

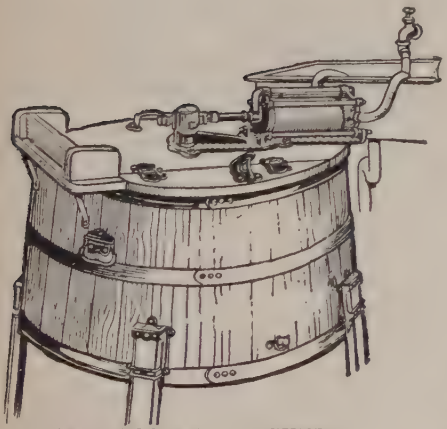
In laundering, the best practice seems to be to soak the white clothes at least, in cold water or in luke-warm suds. The badly soiled portions may be soaped and rolled tightly to keep the soap where it is

Hand Machine

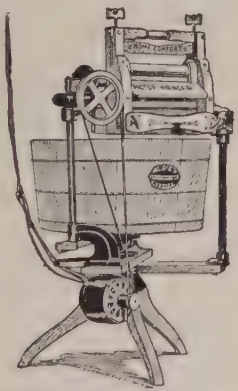


Electric Machine

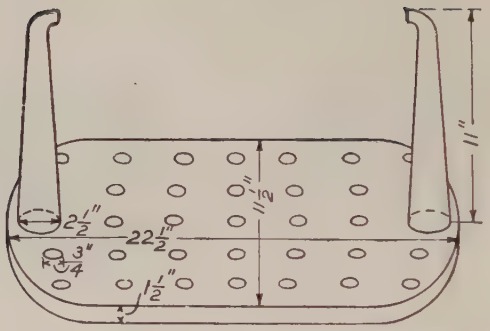
PARAGON WASHING MACHINES
Cylinder type, all metal, sheet iron galvanized



ROTARY TYPE OF WASHER
Piston Water Motor Attached



"1900" WASHER, Electrically Driven.



A MECHANICAL WASHING DEVICE

Made to fit in the bottom of a wash boiler. The formation of steam forces the hot, soapy water up the spouts, over and through the clothes.

SPECIAL IRON HEATER

A gas saver. Made as an attachment to a gas stove and as a separate stove on legs.

most needed. The water should be well softened, and a very little extra washing soda solution may be added. The soaking loosens the dirt and saves much rubbing and hence wear on the clothes. It is probable that the cleansing wears out the articles which make up the weekly wash more than the actual use they receive.

Boiling

After washing the clothes, they may be wrung out and put into a boiler of cold water, which is then heated and boiled briskly for a little while. Whether to boil, or not to boil the clothes depends largely upon the purity of the materials used. If there is any iron in the water, or elsewhere, it is sure to be deposited on the goods, thus producing yellowness. Soap may be added to the clothes in the boiler, or borax may be used, allowing a tablespoonful to every gallon of water. The borax serves as a bleacher and as an aid in the disinfection of the clothes. One great advantage of boiling is the additional disinfection which this insures.

Rinsing

After washing, the clothes should be thoroughly rinsed. They cannot be clean otherwise and proper rinsing is essential to successful washing. The more thoroughly the wash water is removed between rinsings, the less number of rinsings will be required to give the same results.

Bluing

Bluing is frequently added to the last rinsing water to counteract, or cover up, any yellowness. A light blue appears to the eye whiter than a light yellow.

The color is, however, gray in comparison with white. Most of the liquid bluing now on the market contains Prussian Blue, a compound of iron. This compound is decomposed by soap and alkalies, when the goods are next washed, making a slight yellow stain of iron on the cloth. Frequent repetitions of this action may give a distinctly yellow shade to the white goods. The indigo blue used a generation or more ago did not have this objection. It is said that white goods which have never been blued, never require bluing.

Stains

Stains and all special deposits should be removed before the goods are treated with soap or soda, as these frequently set the stains. Hot water will spread any grease and also set many stains, so the clothes when not soaked, should be wet thoroughly in cold or luke-warm water before washing.

Washing Colored Goods

Colored goods and prints require more delicate treatment than white goods. If they are soaked, the water should be cold and contain very little soap and no soda. Only dissolved soap should be used in washing them, and this should be of good quality, free from alkali. They should be dried with the wrong side out and in the shade, for direct sunlight fades colors about twenty times as much as reflected light.

Washing Woolens

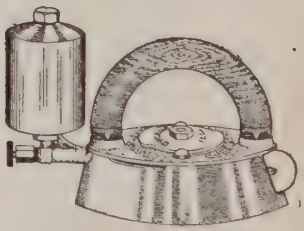
All wool goods require the greatest care in washing. The different waters used should be of the same temperature and never too hot to be borne comfortably by the hand.

GAS-HEATED IRONING MACHINE
Size, 37 inches. Price, $40.00. With Electric Motor, $100

SMALL HEATED HAND MANGLE
Size, 24 inches. Price, $22.00

A COLD MANGLE
Price, $6.75

GENERAL ELECTRIC COMPANY FLAT IRON ON STAND
Price, $3.50 to $5.00



GASOLINE OR ALCOHOL IRON
Price, $5.00

Soap Solution

The soap used should be in the form of a thin soap solution. No soap should be rubbed on the fabric and only a good, white soap, free from rosin, is allowable. Make each water slightly soapy and leave a very little in the fabric at the end, to furnish a dressing as nearly like the original as possible.

Many persons prefer ammonia or borax in place of the soap. For pure white flannel, borax gives the best satisfaction on account of its bleaching quality. Whatever alkali is chosen, care should be exercised in the quantity taken. Only enough should be used to make the water very soft.

Brushing Woolens

The fibres of wool collect much dust upon their tooth-like projections and this should be thoroughly brushed or shaken off before the fabric is put into water. All friction should be by squeezing, not by rubbing. Wool should not be wrung by hand. Either run the fabric smoothly through a wringer or squeeze the water out, that the fibres may not be twisted. Wool may be well dried by rolling the article tightly in a thick dry towel or sheet and squeezing the whole till all moisture is absorbed. Wool should not be allowed to freeze, for the teeth will become knotted and hard. Above all, the drying should be accomplished quickly, and in short, the less time that is taken in washing, rinsing, and drying, the less will be the shrinkage and the better will be the result.

Starching

Some of the clothes are starched. This in addition to making them stiffer and giving them a better appearance helps to keep them clean longer. Practically all the household starch on the market is corn starch, although in the textile industries and large laundries, wheat, potato and rice starches are used. Corn starch has the greatest stiffening effect, but wheat starch and rice starch penetrate better and give a more flexible finish.

Cooked Starch

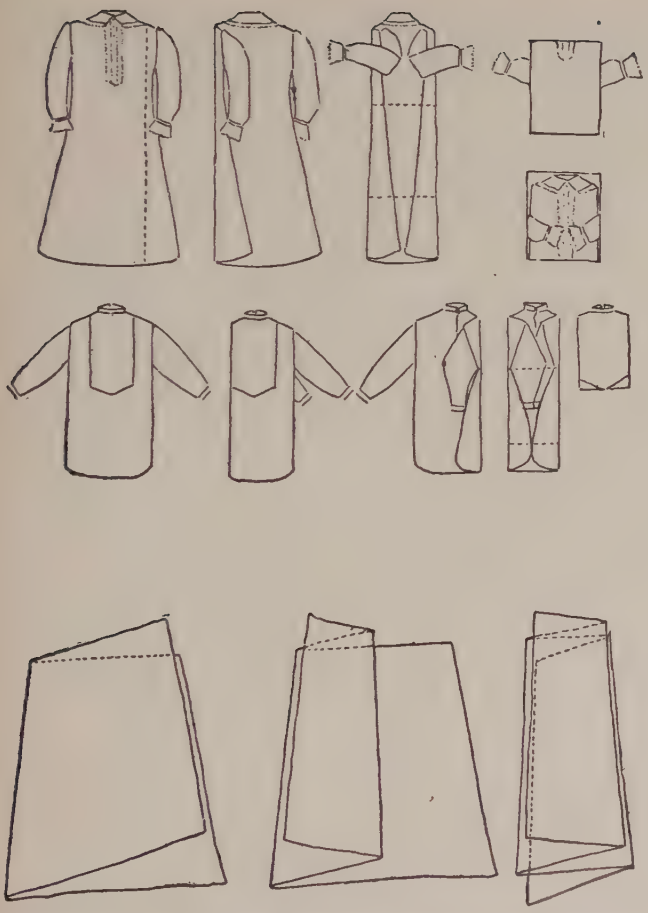
To make cooked starch for ordinary work, wet ¼ cup with ¼ cup of water and pour on one quart of boiling water. Boil thoroughly till clear. Use double the quantity of starch for stiff starching. Borax may be added—½ to 1 level tablespoon to a quart—to increase the gloss and penetrability and to prevent the iron from sticking. Lard, wax or paraffine is sometimes cooked with the starch for the same purpose—¼ tablespoon to a quart.

Uncooked Starch

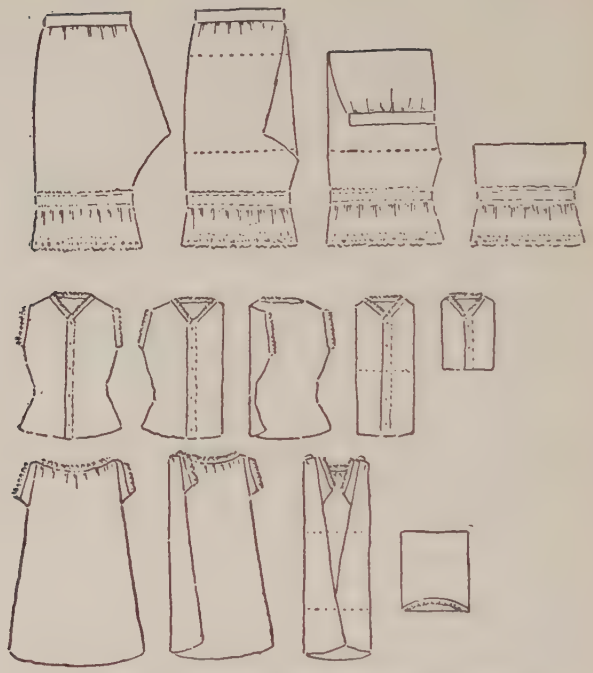
For very stiff starching, as for collars, the thick paste should be rubbed thoroughly into the goods and the excess wiped off with a damp cloth, after which the goods is dried before a fire.

The prepared starches, to be used cold, contain borax. This may just as well be added to cheaper preparations. As the uncooked starch depends upon the heat of the iron to swell and stiffen it, a hotter iron is required than with boiled starch.

For producing an ecru shade in curtains, coffee is sometimes added in quantity to give the desired color. A solution of gum arabic is sometimes used to stiffen



A METHOD OF FOLDING DRESSES, SHIRTS AND SHEETS OR TABLE CLOTHS



METHOD OF FOLDING UNDERCLOTHES

ORDER OF IRONING

Night Dresses:
1—embroidery, 2—sleeves, 3—yoke, 4—body.

Drawers:
1—trimming, 2—tucks, 3—body, 4—band.

Skirts:
1—ruffle, 2—hem, 3—body.

Shirt Waists:
1—cuff, 2—collar band, 3—sleeves, 4—yoke, 5—back, 6—front.

(From "The Laundry," by Flora Rose; Bulletin of the Cornell Reading Course for Farmers' Wives, Ithaca, N. Y.)

dark colored clothes which would show the white color of the starch.

THE REMOVAL OF STAIN

Whenever possible, stains should be removed when fresh. If the staining substance is allowed to dry on the cloth, its removal is always more difficult, and sometimes a neglected spot or stain cannot be removed without damage to the cloth.

Grease Spots

The nature of the spot must be known before the best substance to dissolve and remove it can be chosen. To remove grease spots, solvents of grease should be chosen, though we may remove such spots sometimes by causing the grease to form an emulsion with soap and thus be removed, or the grease may be made into a soap with ammonia or washing soda and thus dissolved and removed in water. The first of the three methods is, as a rule, the best. Grease will dissolve readily in benzine, naphtha, gasoline, kerosene, ether, and chloroform and somewhat in turpentine and hot alcohol. Ether and chloroform are the best solvents, but they are more expensive and not much more effective than naphtha.

Precautions

Caution! All of the solvents for grease are inflammable and some are explosive, so that they should never be used near a fire or light. Work with them should be done in the day time and preferably out of doors.

In applying any of these solvents to grease spots in fabrics, a cloth should be placed underneath the stain to absorb the excess of liquid containing the dissolved grease. The spot should be rubbed from the outside towards the center until dry. This will tend to distribute the solvent and prevent the formation of a ring where the liquid stops. It is well to apply the solvent on the wrong side of the fabric. Old spots of any kind may require long treatment. For this a little lard may be rubbed into the spot and left for some time, then the whole may be dissolved by naphtha or washed out with soap or ammonia.

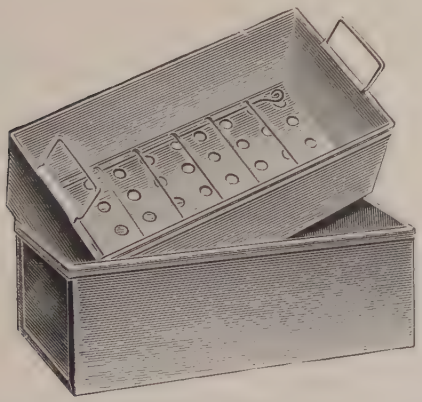
Absorbents

Spots of grease on carpet or heavy material may be treated with absorbents. Heat will assist by melting the grease. Fresh grease spots may often be removed by placing over the spot a clean piece of blotting paper and pressing the spot with a warm iron. French chalk or whiting may be moistened with naphtha and spread over the spot. When all is dry, brush off the absorbent. The absorption method may be used in many other cases, moistening with cleansing agent which will not harm the material treated.

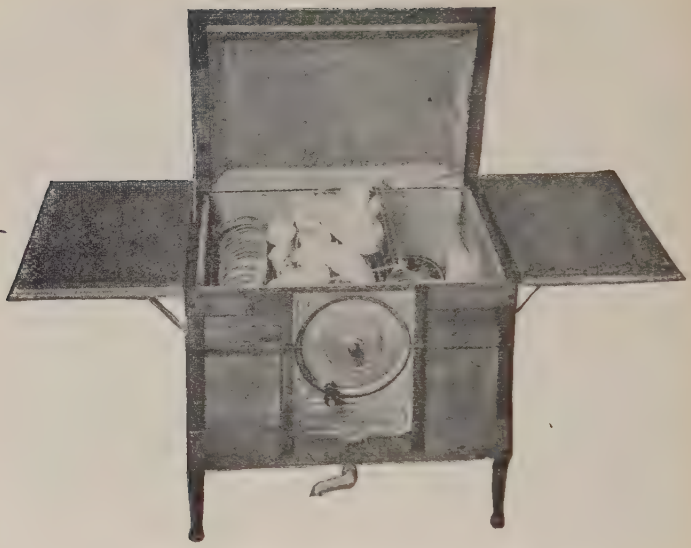
Bluing Stains

Bluing spots may frequently be removed by soaking in strong ammonia water. Alcohol or ammonia will remove grass stains, and an old remedy is to smear the stains with molasses before the article goes into the wash. The acids in the molasses seem to have the desired effect on the grass stains.

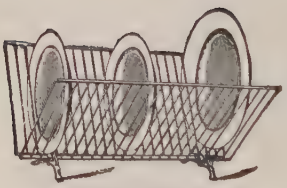
O. K. CLOTHES DRYER. Price $5.00.



RAMSAY-VANCE SILVER-CLEAN PAN. Price $2.00.



FEARLESS DISHWASHING MACHINE. (Price $30.)



Folding Dish Drain.

Frying Basket.

THE A. S. H. E. DISHWASHER. (Price $1.50.)

Coffee and Fruit Stains

Fresh stains of coffee, tea or fruit may be removed by hot water. Stretch the stained part over an earthen dish and pour boiling water upon the stain until it disappears. It is some times better to sprinkle the stain with borax and soak in cold water before applying the hot water. Old, neglected stains of coffee, fruits, cocoa, etc., will have to be treated with some bleaching agent. In many cases, it is not possible to remove them without severely damaging the cloth.

Mildew

Mildew causes a spot of a totally different character from any we have considered. It is a true mold, and like all plants, requires warmth and moisture for its growth. When this necessary moisture is furnished by any cloth in a warm place, the mildew grows upon the fibres. During the first stage of its growth, the mold may be removed, but in time, it destroys the fibres.

Strong soapsuds, a layer of soft soap, and pulverized chalk, or one of chalk and salt, are all effective if, in addition, the moistened cloth be subjected to strong sunlight, which kills the plant and bleaches the fibres. Bleaching powder or Javelle water may be tried in cases of advanced growth, but success cannot be assured.

Vaseline Stains

Some of the animal and vegetable oils may be taken out by soap and *cold* water or dissolved in naphtha, chloroform, ether, etc. Mineral oil stains are not soluble in any alkaline or acid solutions. Kerosene will

evaporate in time. Vaseline stains should be soaked in kerosene before water and soap touch them.

Paint

Paints consist mainly of oils and some colored earth. Spots of paint, then, must be treated with something that will take out the oil, leaving the insoluble coloring matter to be brushed off. Turpentine is most generally useful.

Spots of varnish or pitch may be dissolved by the use of the same solvents as paint. Alcohol is also one of the best solvents here.

Spots made by food substances are greasy, sugary, or acid in their nature. Whatever takes out the grease will generally remove the substance united with it, as the blood in meat juices. Sugar is dissolved by hot water, so sticky spots are best removed with this.

Ink Spots

Ink spots are perhaps the worst that can be encountered, because of the great uncertainty of the composition of inks of the present day. When the character of an enemy is known, it is a comparatively simple matter to choose the weapons to be used against him, but an unknown enemy must be experimented upon and conquest is uncertain.

Indelible Ink

Indelible inks formerly owed their permanence to silver nitrate. Now many are made from aniline black solutions and are scarcely affected by any chemicals. The silver nitrate inks become dark in the sun by a photographic process. Many silver salts, and some salts of other metals, change in color in a bright light.

Silver nitrate inks may be removed by bleaching powder solutions. The chlorine in this replaces the nitric acid forming white silver chloride. This will darken if not at once removed, but will dissolve in strong ammonia water or a solution of hyposulphite of soda. This last salt, much used by photographers, commonly called "hypo," will often dissolve the stain of indelible ink without the use of the bleaching fluid and is less harmful to the fibres. Some inks contain carbon in the form of lamp black which is not affected by any chemicals which can be used.

Writing Ink

The old fashioned black ink is a compound called the gallo-tannate of iron. It is made by adding a solution of sulphate of iron to a water solution of nut galls. A little gum solution is added to make the ink of better consistency. This kind of ink is removed by the addition of a warm solution of oxalic acid or muriatic acid drop by drop, and this finally well rinsed out. Of course some materials will be injured by the acids, so this method must be used with caution. Lemon juice and salt will sometimes remove the spot and is safe. Cover the spot with salt, wet with lemon juice, and spread in the sun. Bleaching powder solution and acid will frequently destroy any ink stain of long standing which acids alone will not affect.

Some ink stains are removed when fresh by clear, cold, or tepid water—skimmed milk is safe and often effective. If the stain is allowed to soak in the milk

until the milk sours, the result is often better. Sometimes the ink will dissolve out if a piece of ice is laid on the spot and blotting paper under it. The blotting paper absorbs the water and should be often changed.

Ink on Carpets

Ink on heavy materials like carpets and draperies may be treated with some absorbent to keep the ink from spreading. Bits of blotting paper, cotton batting, meal, flour, sawdust, etc., may be used and removed as long as any ink is absorbed, then go over the spot repeatedly with a lemon freshly cut, and finally rinse with cold or tepid water. If an ink stain has worked through varnish into the wood, turpentine will usually remove the spot.

Colored Inks

Of late colored inks are generally prepared from aniline colors. These are made from substances produced in the distillation of coal tar. The colors are soluble in water, and by dissolving them and adding to the mixture some thickening substance, different colored inks are produced. They are rather difficult to remove successfully, but bleaching powder solution will frequently destroy them.

Iron Rust

The red iron-rust spots must be treated with acid. These are the results of oxidation—the union of the oxygen of the air with the iron in the presence of moisture. The oxide formed is deposited upon the fabric which furnishes the moisture. Ordinary "tin" utensils are made from iron coated with tin, which soon wears off, so no moist fabric should be left long in tin unless the surface is entire.

Removing Rust

Iron-rust is, then, an insoluble oxide of iron. The chloride of iron is soluble and so hydrochloric acid is used to remove the rust. The best method of applying the acid is as follows: Fill an earthen dish two-thirds full of hot water and stretch the stained cloth over this. Have near two other dishes with clear water in one and ammonia water in the other. The steam from the hot water will furnish the heat and moisture favorable for chemical action. Drop a little hydrochloric (muriatic) acid on the stain with a medi-

FIG. 19. REMOVING IRON RUST STAIN.

cine dropper. Fig. 19. Let it act a moment, then lower the cloth into the hot water. Repeat till the stain disappears. Rinse carefully in the clear water and, finally, immerse in the ammonia water, that any excess of acid may be neutralized and the fabric protected.

Salt and Lemon Juice

Salt and lemon juice are often sufficient for a slight stain, probably because a little hydrochloric acid is formed from their union.

Ink stains on colored goods are often impossible to take out without also removing part of the dye. The ink must be washed out in cold water *before* it dries; any slight stain remaining can, perhaps, be removed with a weak acid like lemon juice without harming the color.

BLEACHING

When the clothes are washed, the mistress likes to have them hang out of doors where the air and sunshine can dry them. She is glad when the white articles can be spread on the grass, knowing that they will be made whiter by Nature's bleaching agent. The sunlight is the chief agent in this bleaching and the articles are laid flat on the grass so that the rays of light will strike in a more perpendicular direction. There are also other devices for bleaching, among which are the fumes of burning sulphur, chloride of lime (bleaching powder) and Javelle water.

Originally all bleaching of linen and cotton was done out of doors by the action of oxygen, water, and sunlight. In these days of great factories, this process is impossible for lack of space; but various artificial bleaching stuffs have been discovered whose action is satisfactory if skilfully used.

Bleaching Powder

Chlorine is a gas which has remarkable readiness to combine with other bodies. It is even more energetic than oxygen. By its action upon them, chlorine destroys the greater number of coloring substances. Be-

cause of its harmful action upon the human body, chlorine gas itself cannot be used in factories or in the household, but the compound which chlorine forms with lime (oxide of calcium) known as *chloride of lime* or *bleaching powder,* is safe and effective.

Action of Chlorine

The principal coloring matters are composed chiefly of the elements carbon and hydrogen and some of the metals. If a substance which makes new combination with the elements present is brought in contact with these colors, the new compounds thus produced may be colorless. The element chlorine does just this. It can be set free from chloride of lime by weak acids, and will dissolve very readily in water when so set free. By dipping colored cloth into a weak solution of chloride of lime and acid, many colors and stains are at once destroyed. But the energy of the chlorine is not stopped by this process. Having destroyed the color, the bleaching powder attacks the fibres of the goods, unless the cloth is at once placed in some solution which can neutralize the bleaching powder. There are several such easily obtained and used. The use of bleaching powder in the household is frequently of dubious success for lack of this precaution. Ammonia water will perform this action satisfactorily, since the harmless soluble salt, ammonium chloride, is formed; hypo-sulphite of soda is also effective.

Chloride of Lime

Chloride of lime loses strength rapidly if exposed in an open vessel. It absorbs water and carbon di-

oxide from the air, grows damp and the chlorine gas escapes.

In using bleaching powder, mix one or two teaspoonfuls with a pint of cold water in an earthenware dish. The effective part of the powder will be dissolved, so let the mixture settle, or strain off the liquid through a cloth. Add a little vinegar or a few drops of acetic acid to the nearly clear solution and use at once.

Javelle Water

Javelle water is also used as a bleaching agent. It is very like bleaching powder, except that soda replaces the lime. It is prepared by dissolving one pound of washing soda in a quart of hot water and adding one quarter of a pound of chloride of lime also dissolved in a quart of hot water. Let the mixture settle, pour off the clear liquid and bottle it for use. It will keep for some time. The dregs may be used to scour the kitchen floor or to disinfect waste pipes. This is very useful in removing stains on white cloth, but the addition of some solution to neutralize the action is always necessary, just as with bleaching powder. The best substance to use for this is hypo-sulphite of soda, the "hypo" used in photography, which is quite harmless to the cloth.

Sulphur Dioxide Bleaching

Chlorine cannot be used in bleaching fabrics of animal fibre such as wool and silk; it leaves them yellow rather than white. For these the fumes of burning sulphur, or these fumes dissolved in water must be

used. No special means of destroying the excess of sulphur fumes is required. These fumes are a compound of sulphur and the oxygen of the air and familiar to every one, in the acid fumes from a burning "sulphur match." The article to be bleached must be *wet*, and then hung in some enclosed space above a piece of burning sulphur. The sulphur candles, to be had at any druggist's, are convenient for this use. Fig. 20. The fumes have great affinity for oxygen, that is, unite with it easily, and take it from the coloring stuffs, converting them into colorless ones. This method of bleaching is sometimes not permanent.

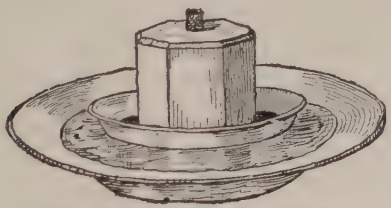


FIG. 20. A SULPHUR CANDLE.

Disinfection

These fumes of sulphur are often used to disinfect rooms where there has been sickness. Its power in this respect is far less than is generally supposed however, and much larger quantities of the gas are required for thorough work than are commonly used. Chlorine gas is an excellent disinfectant, but is dangerous to use because of its irritating effect upon the throat and lungs. The use of "chloride of lime" as a disinfectant depends upon the fact that chlorine slowly

escapes from this substance when it is exposed to the air.

Hydrogen Peroxide

Another bleaching agent of growing importance is peroxide of hydrogen. Water is a compound made up of one-third oxygen and two-thirds hydrogen. Under certain conditions, a compound half oxygen and half hydrogen may be prepared. This is not very permanent as the extra oxygen slowly escapes. This extra oxygen has great power as a decolorizer. The peroxide is a liquid much like water in appearance and is used in bleaching hair, feathers, and ivory. It is the safest bleaching agent for the housekeeper to work with and may be used on wool and silk as well as cotton and linen.

CLEANING WOODWORK

In the interior of the house woods are seldom used in their natural state. The surface is covered with two or more coatings of paint, varnish, etc., which add to the wood durability or beauty. The cleaning processes are applied to the last coat of finish and must not injure this.

Soft woods are finished with paint, stain, oil, shellac, varnish, or with two or more of these combined; hardwoods with any of these, and in addition, wax, or wax with turpentine, or both with oil.

Alkalies on Paint

All these surfaces, except those finished with wax, may be cleaned with a weak solution of soap or ammonia, but the continuous use of any alkali may im-

pair and finally remove the polish. Refinishing will then be necessary. Waxed surfaces are turned dark by water. Finished surfaces should never be scoured nor cleaned with strong alkalies, like sal-soda, or potash soaps. Scouring with these strong alkalies will break the paint or varnish and in this way destroy the finish.

Kerosene in Cleaning

A few drops of kerosene or turpentine on a soft cloth may be used to clean all polished surfaces. The latter cleans them more perfectly and evaporates readily; the former is cheaper, safer, because its vapor is not so inflammable as that of turpentine, and it polishes a little while it cleans; but it evaporates so slowly that the surface must be rubbed dry each time, or the dust will be collected and retained. The harder the rubbing, the higher the polish.

Outside the kitchen, the woodwork of the house seldom needs scrubbing. The greasy layer is readily dissolved by weak alkaline solutions, by kerosene or turpentine, while the imbedded dust is wiped away by the cloth. Polished surfaces keep clean longest. If the finish be removed or broken by deep scratches, the wood itself absorbs the grease and dust, and the stain may have to be scraped out.

CLEANING METALS

Most metals may be washed without harm in a hot alakline solution or wiped with a little kerosene. Stoves and iron sinks may be scoured with the coarser materials like ashes, emery or pumice; but copper, pol-

ished steel, or the soft metals, tin, silver, and aluminum require a fine powder that they may not be scratched or worn away too rapidly. Metal bathtubs may be kept clean and bright with whiting and ammonia, if rinsed with boiling hot water and wiped dry with soft flannel or chamois.

Porcelain or soapstone may be washed like metal or scoured with any fine material.

Tarnish

The special deposits on metals are caused by the oxygen and moisture of the air, by the presence of other gases in the house, or by acids or corroding liquids. Such deposits come under the general head of tarnish.

The metals, or their compounds, in common use are silver, copper and brass, iron and steel, tin, zinc and nickel. Aluminum is rapidly taking a prominent place in the manufacture of household utensils.

There is little trouble with the general greasy film or with the special deposits on articles in daily use, if they are washed in hot water and soap, rinsed well and wiped dry each time. Yet certain articles of food act upon the metal of tableware and cooking utensils, forming true chemical salts.

Silver Sulphide

The salts of silver are usually dark colored and insoluble in water or in any alkaline liquid which will not also dissolve the silver. Whether found in the products of combustion, in food, as eggs, in the paper or cloth used for wrapping, in the rubber band of a fruit jar, or the rubber elastic which may be near the

silver, sulphur forms with silver a grayish black compound—a sulphide of silver. All the silver sulphides are insoluble in water. Rub such tarnished articles, before washing, with common salt. By replacement, silver chloride, a white chemical salt, is formed, which is soluble in ammonia. If the article be not washed in ammonia it will soon turn dark again. With an old or deep stain of silver sulphide friction must be used.

Silver Polish

The analysis of many samples of silver polish, showed them to be made up of either precipitated chalk, diatomaceous earth or fine sand. In using them, it is necessary to be careful in regard to the fineness of material since a few coarse grains will scratch the coating of soft silver. In former times the housewife bought a pound of whiting for fifteen cents, sifted it through fine cloth, or, mixing it with water, floated off the finer portion, and obtained in this way, twelve ounces of the same material for three ounces of which the modern housewife pays twenty-five cents or even more, when she buys it "by the box."

Whiting

The whiting may be made into a paste with ammonia or alcohol, the article coated with this and left till the liquid has evaporated. Then the powder should be rubbed off with soft tissue paper or soft cotton cloth, and polished with chamois.

Protecting Metals

The presence of water always favors chemical change. Therefore iron and steel rapidly oxidize in damp air or in the presence of moisture. All metallic articles may be protected from such action by a thin

oily coating. Iron and steel articles not in use may be covered with a thin layer of vaseline.

Rust can be removed from iron or steel by kerosene if not too deep.

The tarnish on brass or copper will dissolve in ammonia water, but the objects tarnish again more quickly than if polished by friction.

CHEMISTRY OF THE HOUSEHOLD.

PART II.

Read Carefully. Place your name and address on the first sheet of the test. Use a light grade of paper and write on one side of the sheet only. *Do not copy answers from the lesson paper.* Use your own words, so that your instructor may know that you understand the subject. Read the lesson paper a number of times before attempting to answer the questions.

1. Name all the substances you can think of which are not soluble in water and are soluble in naphtha or benzine.
2. Does sugar neutralize acid chemically? Why?
3. How is soap made? What is the difference between hard and soft soap?
4. What is "hard" water? How does it act with soap? How is it softened?
5. Explain how "bluing" may make white clothes yellow.
6. Why remove stains when fresh? Why before washing?
7. Why is there danger in using naphtha, benzine, and to some extent alcohol near a light?
8. How do cotton and woolen differ in the effect of acids and alkalies upon them?

9. What precautions must be taken in bleaching or removing stains with chloride of lime solution or with Javelle water?
10. Why is it necessary to have clothes dry before starching if much stiffness is desired?
11. If possible, try to remove some stain by a method given in this lesson and tell of the results.
12. Describe a good method of washing woolens.
13. Why does the drying of a little acid or alkali on a fabric have a very disastrous effect?
14. What is your method of washing dishes?
15. What can you say of acids, alkalies, salts?
16. What is "washing soda?" How should it be used? When should it *not* be used?
17. Why does strong soap or washing soda harm varnish or paint?
18. How does the chlorine in "chloride of lime" bleach?
19. What advantages has ammonia for use in the laundry?
20. Do you understand everything given in this lesson paper? Are there any questions you would like to ask?

NOTE.—After completing the test sign your full name.

CHEMISTRY OF THE HOUSEHOLD.

A Day's Chemistry.

PART III.

CHEMISTRY OF BAKING POWDER

We will suppose that after the strenuous course of cooking, washing, and cleaning outlined for the morning, that the housekeeper still has strength to make soda biscuits for tea, and we will study the chemical action involved.

One of the first chemical methods of securing carbon dioxide to use in making bread rise, was by putting hydrochloric acid and cooking soda together in a dough which might be put into the oven before the gas escaped from it.

Cooking Soda

Cooking soda is a salt called bi-carbonate of sodium. It differs from the ordinary mono-carbonate of soda (washing soda) in yielding twice as much carbon dioxide in proportion to the sodium part of the compound. The saleratus of our grandmother's time was bi-carbonate of *potash*, made from wood ashes. The name is still used, but at all stores, cooking soda would be delivered invariably if saleratus were asked for. The true saleratus costs ten times as much as the soda and is no more effective. The carbonic acid is easily set free by chemical compounds of an acid nature, and new chemical compounds result.

Experiment. Put a little cooking soda into any acid—lemon juice, vinegar, almost any fruit juice—and the carbon dioxide will be seen to escape in tiny bubbles. Part of the acid unites with part of the soda, forming a new salt, and the acid taste will be much reduced or lost.

Heating Cooking Soda

Part of the carbon dioxide in sodium bi-carbonate is driven off by simply heating, leaving ordinary sodium mono-carbonate, washing soda. In using this process, cooking soda is mixed with the flour. The high temperature of the oven drives off carbon dioxide, and the bread puffs up. It is light, but yellow in color. The sodium carbonate remains in the bread and its alkaline nature serves to neutralize the acid fluids of the stomach (gastric juice) so that digestion of the bread may be retarded. The sodium carbonate also acts in some way upon the gluten producing an unpleasant odor.

Early Experiments

Among the first methods proposed was one undoubtedly the best theoretically, but very difficult to put in practice. This depended upon the liberation of carbon dioxide from bi-carbonate of sodium by means of muriatic acid—the method already described. The liberation of gas is instantaneous on the contact of the acid with the "soda" and even a skilled hand cannot mix the bread and place it in the oven without the loss of much of the gas. Tartaric acid, the acid phosphates, sour milk (lactic acid), vinegar (acetic acid),

alum, all of which have been used, are open to the same objection.

Cream of Tartar

Cream of tartar is the only acid substance commonly used which does not liberate the gas by simple contact in cold solution. It unites with "soda" only when heated, because it is so slightly soluble in cold water.

Experiment. To illustrate this stir a little soda and "cream of tartar" into some cold water in a cup. In another cup mix the same amounts of each in warm water. Note the difference in the action produced.

To obtain an even distribution of the gas by thorough mixing, cream of tartar would seem to be the best medium by which to add the acid, but because there are other products which remain behind in the bread in using all the so-called baking powders, the healthfulness of these residues must be considered.

Common salt is the safest residue and perhaps that from acid phosphate is next in order.

The tartrate, lactate, and acetate of sodium are not known to be especially hurtful. As the important constituent of Seidlitz powders is Rochelle salt, the same compound as that resulting from the use of cream of tartar and "soda," it is not likely to be very harmful, even in the case of the habitual "soda biscuit" eater, because of the small quantities taken.

Injurious Products

The various products formed by the chemical decomposition of the alum and "soda" are possibly the most injurious, as these are sulphates, and are thought

to be the least readily absorbed salts. The sale of "alum" baking powder is increasing, as it is cheaper.

Taking into consideration then the advantage given by the insolubility of cream of tartar in cold water, and the comparatively little danger from its derivative —Rochelle salt—it would seem to be, on the whole, the best substance to add to the soda in order to liberate the gas, but the proportions should be chemically exact, since too much alkali would hinder the process of digestion. Hence baking powders prepared by weight and carefully mixed, are a great improvement over cream of tartar and "soda" measured separately. As commonly used, the proportion of soda should be a little less than half.

LIGHTING

By the time supper is over or even before, during a large portion of the year daylight has gone. Our grandmothers would have brought out the candles. Perhaps we shall use a candle to light our way while we carry the butter and food into the cool cellar.

The Candle Flame

The candle flame although small in area is typical of all flames. Flame indicates the burning of a gas for solid substances in burning simply glow and do not burn with flame. When wood and soft coal burn, gases are set free by heat and these gases burn over the bed of fuel, giving the flames.

The general form of the candle flame is a cone widest above the base, or about at the top of the wick. If it is examined carefully it will be seen to consist

of three layers. Fig. 21. The interior part is dark, giving out no light. The second is yellow and is the luminous part, and surrounding this and most easily seen at the base, is a very thin blue layer.

Experiment. If a small splint of wood or a match be placed across the lower part of the flame near the wick for a moment, it will be charred where the outer layers of the flame have touched it, but the centre will not be changed. Press a piece of card board quickly down on the flame from above and remove it before it is set on fire, and a ring of scorched paper will show the shape of the hot part of the flame.

Fig. 21. Flame of a Candle.

The candle consists of hydrocarbons (compounds of carbon and hydrogen). When a match is applied to the wick, the hydrocarbons are melted and the liquid rises on the wick by capillary attraction. The heat changes this to gas (or vapor) which is set on fire, since at the high temperature it easily unites with the oxygen of the air. There is plenty of oxygen present, but it is all seized upon by the carbon and hydrogen in the outer parts of the column of gas rising from the wick, so that none reaches the centre. The gas diffuses outward toward the oxygen continually, so that the inner cone may be regarded as a gas factory. The yel-

Chemistry of the Candle Flame

low light is caused by the incandescence or glowing of small particles of carbon, heated to "white heat." These are set free from the compounds where the flame is very hot and they are not yet united with oxygen.

Nature of Smoke

Flames "smoke," that is, throw off unburned carbon when there is an insufficient supply of oxygen. Any device which constantly renews a steady supply of air (with oxygen) will make the flame burn better. The chimney of a lamp does this by protecting the flame from wind and by making, enclosing, and directing upward a current of air. The chimney makes the lamp "draw," as the chimney of the house makes the stove "draw."

Explosions

When the air is mixed with an inflammable gas and the temperature of any part is raised to the kindling point of the gas, as happens if a light is brought into such a mixture, an explosion takes place. The flame spreads through the whole and combination ensues everywhere almost instantly. Great heat is produced and the gases expand suddenly and with violence. If the gases are confined, the enclosing walls may be broken by the pressure. Contraction follows this expansion and air rushes in, producing a second sound. The sounds occur so near together as to give the impression of one.

Explosive Mixtures

In a mixture of inflammable gas and air there must be a certain proportion of each to give conditions which will produce an explosion. A very small amount of gas in the air will not explode under any conditions,

as when there is an odor of coal gas in the room from which no explosion follows even though a light be present. On the other hand, a mixture containing a large proportion of inflammable gas and a little air will not explode. The proportion of air to gas in an explosive mixture varies in different cases, but in general ranges from about twelve to five parts of air to one

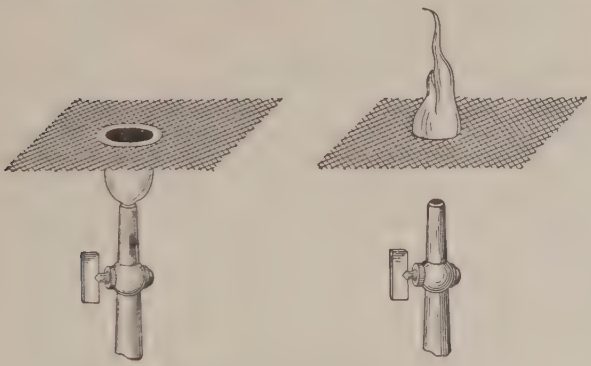


Fig. 22a. The Effect of Wire Gauze on a Gas Flame.

part of gas. It is, of course, never safe to rely on the chance of the correct proportions of gas and air not being present.

Explosions sometimes occur by unwise use of kerosene in kindling a fire in a stove. If the kerosene is poured upon a fire already burning, enough vapor of kerosene may be produced to give a disastrous explosion. Soaking wood or paper in kerosene for use as kindlings and then lighting would produce no such dire results.

Safety Lamps

Explosions in mines are usually caused by a gas called fire-damp and composed of carbon and hydrogen. When this escapes from the coal and becomes mixed with air, it is very explosive. If a miner brings a naked flame into the mine, the fire-damp will ignite and disaster results. A safety lamp was devised by Davy for use in such dangerous places. It was found that a gas is cooled below its kindling temperature in passing through a fine wire gauze. Lamps surrounded by such a gauze may be taken into a mine with comparative safety. Fig. 22.

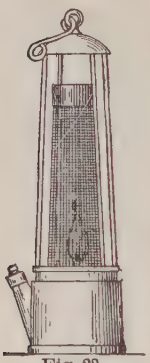


Fig. 22

The action of the wire gauze upon the gas may be studied by holding over a gas jet a piece of fine wire netting, such as is used in window screens, and then lighting the gas above the netting. Fig. 22a. It will be seen that the gas below the netting is very slow in igniting, since it does not readily become sufficiently heated, the wire netting cooling it below its kindling point.

Kerosene Lamps

The kerosene lamp gives light by the principle already described. The reservoir of the lamp corresponds to the cup of melted tallow at the top of the candle. The oil is drawn to the top of the wick by capillary attraction, where the heat vaporizes it; so that vapor and not oil is what really burns. The structure of the flame is precisely like that of the candle, although its shape differs, because of the shape of the wick.

Coal Gas

Illuminating gas is today the source of light in most city houses. There are two kinds of gas now furnished for this purpose. Coal gas is obtained from the destructive distillation of soft coal. Receivers or retorts of iron or fire clay are filled with soft coal and heated to 1100° or more. From these retorts tubes lead up into a large pipe called the hydraulic main,

Distillation of Coal

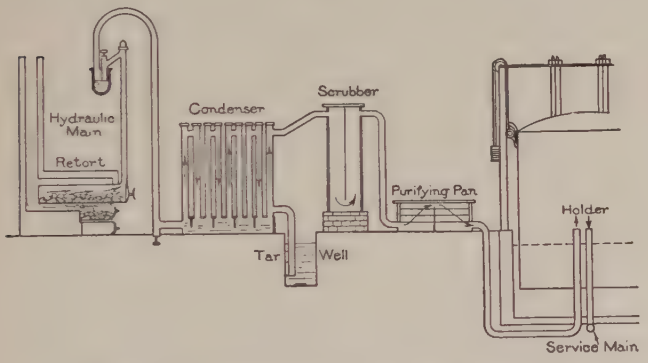


FIG. 23. MANUFACTURING OF COAL GAS.

through which water is kept flowing. As the coal becomes heated, a number of different substances are given off, which at this high temperature are in the gaseous state. Some of them dissolve in the water of the hydraulic main, but those needed for illuminating gas are not soluble and passing out of the main, they travel through several hundred feet of vertical pipe called the condenser, where more water removes any impurities which may have escaped from the hydraulic main.

Purifying Coal Gas

The gases are then passed on through numerous other devices to remove remaining traces of impurities, and are finally collected in a circular chamber known as the gas-holder, from which they are distributed to the consumer. Fig. 23.

If the purification is not perfect, the coal gas will contain sulphur compounds, and these on burning produce oxide of sulphur, which is further changed by moisture and the air into sulphuric acid. The quantity produced may be very minute and yet in time may be sufficient to damage books and fabrics.

Aniline

The materials which collect in the hydraulic main and the condensers contain many useful substances, one of the most valuable being ammonia. Among the most interesting substances obtained from coal tar is aniline from which beautiful dyes are made. Aniline itself is a colorless liquid, but in combination with other chemical substances it yields a wide range of beautiful colors now used in dyeing. Other useful substances obtained from the distillation of coal tar are carbolic acid, a disinfectant, and naphthalene which is sold in the form of moth balls.

Water Gas

In some cities what is known as water gas forms the basis of the illuminating gas. This is made by passing very hot steam over red hot anthracite coal or coke. The oxygen of the water unites with the carbon of the coal, forming carbon monoxide—a compound of one part oxygen and one part carbon—and the hydrogen of the water is set free. Both the gases

thus formed will burn, but in burning they produce a colorless flame. It is therefore necessary to mix with them some gases containing much more carbon which will give light when burning. The mixture is stored and distributed like coal gas.

This gas is cheaper to manufacture in most localities, but it contains much more carbon monoxide which is a very poisonous gas. Much discussion has arisen as to the safety of using water gas and in some places its manufacture is forbidden by law.

Natural Gas

The destructive distillation of vegetable and animal life in the depths of the earth, caused by the great heat within the earth, has in some places given rise to petroleum and natural gas. The gas gave a cheap and convenient fuel, but unfortunately the supply is becoming rapidly exhausted.

Acetylene

An illuminating gas of growing importance today is acetylene. This is a compound of carbon and hydrogen and is prepared by the action of water upon calcium carbide, which is a compound of carbon and the element calcium. Calcium carbide is manufactured in large quantities at Niagara Falls where pure lime mixed with powdered charcoal is fused at an intense heat. A dark gray crystalline solid results which, when mixed with water, produces acetylene gas and slaked lime.

Acetylene is a colorless gas of characteristic odor, soluble in water, and explosive if mixed with air. With an ordinary burner it makes a yellowish smoky

flame, but with a properly constructed burner, it gives a brilliantly white light, very like sunlight. Colors appear at their true values seen in this light. The flame is an intensely hot one. In acetylene burners the gas escapes through two very minute holes directed obliquely towards each other, as shown in Fig. 24.

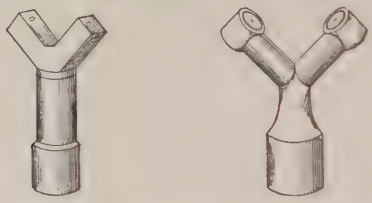


FIG. 24. ACETYLENE GAS BURNERS.

Acetylene Generators

The gas has been somewhat in disrepute because of lack of a suitable arrangement for making and storing it. Many generators are upon the market, it is true, but very few of these are really safe. As soon as a reliable one is obtainable, the gas will be widely used for lighting. It may also be used for cooking, but at present is rather expensive. One form of generator is illustrated in Fig. 25. The calcium carbide in lumps is fed automatically into water as long as the gas is used. When the storage tank is nearly full the supply of carbide is automatically shut off. In another style, which is also automatic, water is fed on to the lumps of carbide. Both styles have their advocates, but the lump feed generator is most generally recommended. The apparatus costs from about $65.00 for a 10 light plant to $300.00 for a 100 light plant.

Gasoline Gas

A cheaper gas than acetylene is gasoline gas, sometimes called carburetted air gas because it is common air impregnated with the vapors of gasoline. It burns with a rich, bright flame similar to coal gas and

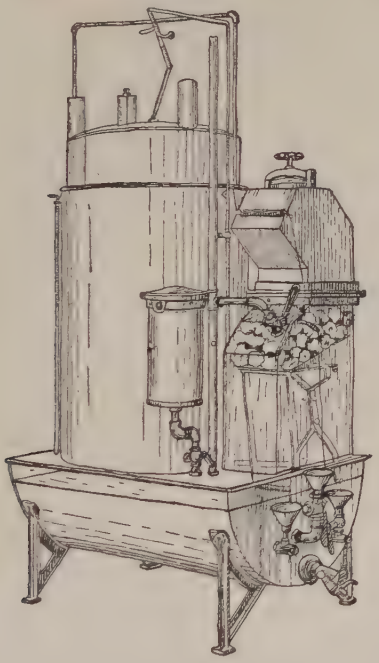


Fig. 25. Acetylene Gas Generator and Storage Tank.

is conducted through pipes and fixtures in the same manner. It may be used in an ordinary gas stove.

The gas machine consists of a generator containing evaporating pans, an automatic air pump operated by

a heavy weight or by a water motor, together with a regulator or mixer. The general arrangement is shown in Fig. 26, the generator being entirely outside the building in which the gas is used. All such machines require intelligent care, for several disastrous

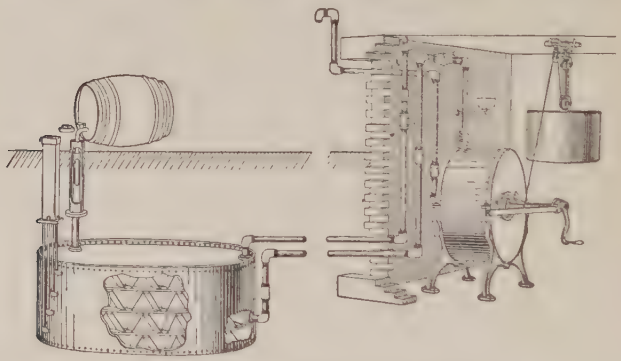


FIG. 26. GASOLINE GAS PLANT.

explosions have taken place when such care has not been given to the apparatus.

LIME.

One of the common chemical substances found about the country house at least is quick lime, used for whitewash and as a deodorizer.

Oxide of Calcium

The term lime usually means the oxide of the element calcium. Its commonest compound is calcium carbonate which is found in nature as limestone, chalk, marble, coral, shells, and several other familiar substances. Calcium is also found combined with sulphur and

oxygen in the compound calcium sulphate, which is the mineral gypsum from which plaster of Paris is made. Bones contain a considerable amount of calcium phosphate and egg shells, calcium carbonate.

Quick Lime

Lime, the oxide of calcium, is made by heating broken pieces of limestone in furnaces called lime kilns. The calcium carbonate as a compound is broken up, carbon dioxide gas being given off and calcium oxide left. This freshly formed oxide is called "quick lime," and when it is exposed to moist air, it attracts water and changes to a form called chemically, calcium hydroxide and, commonly, "slaked lime." Quick lime may be used to dry the air of damp cellars, etc., because of this property. The process of slaking the lime is also accomplished by treating quick lime with water. When this is done, much heat is evolved and the hard lumps crumble to a soft powder and increase considerably in bulk. The rise in temperature shows that chemical change is taking place.

Lime Water

Slaked lime will dissolve slightly in water, yielding lime-water. This is a mild alkali and has several household uses. It may be prepared by pouring two quarts of boiling water over about a cubic inch of unslaked lime. Stir it thoroughly and let it stand over night; in the morning pour off the liquid and treat the sediment with hot water a second time. When the sediment has again settled, pour off the clear liquid and bottle this. It is mixed with milk and fed to young children and invalids to prevent acidity of the

stomach and make the milk more easily digested. Lime-water and oil form one of the best remedies for burns. The alkali of the lime neutralizes the acid nature of the burn.

Mortar and Plaster

Mortar is made of slaked lime and sand. When this is spread upon the walls, the lime slowly absorbs carbon dioxide, always present in the air, and changes to carbonate of lime. The water is given off into the air (evaporates) and the mass becomes hard. Of course the surface becomes carbonate sooner than the deeper parts because this has closer contact with the air, and it therefore takes considerable time for all the plaster to harden. The water contained in the mortar soon dries, but while the mortar is becoming hard, more water is continually formed in the chemical process, so that it requires a long time for the new plaster to become quite dry. It is considered unhealthy to live in rooms with newly plastered walls. This may be because such walls are damp, thus producing damp air, or it may be because the moisture in the walls interferes with the passage of air and other gases through the walls—a process little considered as a rule, but of great importance.

Hydraulic Cement

Certain varieties of limestone contain other salts, such as magnesium carbonate. Lime made from these does not soften from exposure to the air. It will, however, harden after long contact with water, and such substances are known as *cements*. Portland cement will harden under water.

Quick-lime is a strong alkali and does the work of such substances. It is used in tanneries in taking hair from hides and also in decomposing fats for making candles. When dead animal substance is buried in lime, the process of decomposition is greatly hastened, probably because the lime unites with all water present while the strong alkali acts upon the fats reducing them to soaps of different kinds.

Whitewash

Whitewash is simple slaked lime mixed with water. It is very cleansing in its effects and also gives the appearance of freshness and cleanness. When newly applied, it is nearly colorless, for the calcium hydrate is colorless; this in the air soon changes to calcium carbonate which is white and opaque.

CHEMISTRY AND ELECTRICITY.

In most houses electricity is used for operating the door bell, table bell and perhaps the electric gas lighters. We have learned how stored up chemical energy is changed into heat and force in the stove and in the human body; but in the electric cell, chemical energy is changed into electrical energy.

A Voltaic Cell

If a strip of pure zinc be placed in a weak solution of acid, no chemical action takes place. Place in the same solution a strip of sheet copper and again no action takes place; but let the copper and the zinc be brought in contact, or connected by a copper wire, and immediately vigorous chemical action will begin at the surface of the copper plate; bubbles of hydrogen collecting there. This action is as follows: the zinc dis-

solves in the acid and hydrogen is set free. This hydrogen travels with an electric current set up in the liquid, passing from particle to particle through the liquid until it reaches the copper. Here the hydrogen stops, but the electric current passes up the copper plate and over the wire to the zinc and down that to

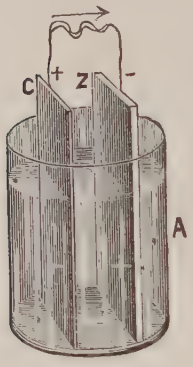


Fig. 27. A Simple Voltaic Cell.

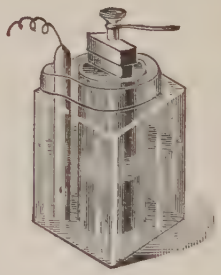


Fig. 28. A Leclanche Cell.

the liquid and so on. This arrangement of acid and metals is called a *simple voltaic cell*. Fig. 27.

Leclanche Cell

Other cells are arranged with different liquids and solids to gain various ends, and several cells may be united by wires between the plates to gain additional strength of current. The form of cell often employed to work electric bells is the Leclanche cell. Fig. 28. This consists of a plate of carbon (or a porous cell containing carbon), in place of the copper, a strip or rod of zinc, and a solution of ammonium chloride

which takes the place of the acid. The zinc is not affected by the ammonium chloride unless it is connected with the carbon, but when there is a circuit for the electricity, a current is generated. The common conductors of the electric current are the metals and carbons.

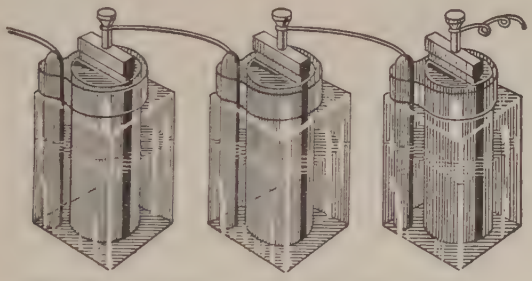


Fig. 29. A Battery of Cells Connected in Series.

Renewing Batteries

The zinc is gradually changed to zinc chloride, at the expense of the ammonium chloride, and after a time both the zinc and the ammonium chloride must be renewed. In renewing the battery, the jars should be cleaned out carefully and the zincs renewed if they are completely eaten through. A quarter of a pound of pure ammonium chloride (sal-ammoniac) is dissolved in enough water to about half fill a jar. When the carbon and the zinc are replaced, this will bring the liquid up to two inches from the top. The jar should not be filled too full. The wires which have been disconnected should be reconnected as before.

Cells in Series

For bell work the cells are usually connected up "in series," that is, the zinc of one cell is connected to

the carbon of the next, the outside circuit being established between the end carbon and end zinc. Fig. 29.

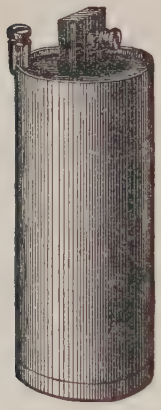


Fig. 30. A Dry Cell.

If there is a short circuit anywhere in the line, that is, if the current has a chance in any way to flow from one wire to the other without going through the bell or other apparatus, the batteries are very quickly exhausted.

A modification of this cell has been made in which the spaces inside it are filled with some spongy mass in the pores of which the ammonium chloride is held. These may easily be carried about without danger of spilling solutions. They are called *dry cells* and when exhausted cannot readily be renewed.

PLANTS.

Most housekeepers have at least a few house plants and many have gardens which occupy part of the time each day. All foods are directly or indirectly produced by plants and it is well to consider also what food these living things require in their turn.

Plant Foods

Plants are able to take from the materials forming the crust of the earth and from the air surrounding them all that they need for their life. The leaves of the plants, because of the green substance called

chlorophyl, have the power of decomposing carbon dioxide gas in a such a way that plants make use of the carbon and breathe out oxygen. Fig. 31. This separation is very difficult to make in the laboratory. The energy of sunlight is utilized by the plant for this work, for the action does not take place in darkness. In this way plants return to the air the oxygen so necessary for animal life and are themselves fed in part by the useless and even harmful gas exhaled by animals.

Chlorophyl

Fig. 31. Section Through a Leaf.

The soil on which the plant grows furnishes the mineral matter needed. When plant tissues are burned, these mineral substances remain as ashes. When the ashes of plants are analyzed, they are found to consist of potash, soda, iron, and lime in the form of phosphates, sulphates, and silicates. Some of these substances are present in the soil in inexhaustible quantities, but others are less abundant and unless the soil be fertilized from time to time, the plant soon uses them up. These less abundant substances are phosphates, potash, and nitrogen.

Fertilizers

The lover of house plants has long resorted to various expedients for feeding them, and many plant foods are now sold and in common use. In using these for manuring potted plants, care must be taken not to

use too much, since strong solutions of them are likely to corrode the roots and kill the plants.

Nitrogen and Plant Life

Although nitrogen is a very abundant element, forming as has been said, four-fifths of the air, yet it is comparatively rare in forms which are of use to plants. As a rule plants cannot take it from the air and therefore require soluble compounds of nitrogen for food. One of the most important of these is ammonia. This is formed when organic substances decay, its odor being very noticeable about stables. Its action with acids was described in the pages about cleaning and it was explained how it unites with acids to form salts, usually soluble. Sulphate of ammonia is the form used in agriculture. A *very little* ammonia in the water used on house plants is a good thing for them.

It has been seen that plants by aid of sunlight breathe in carbon dioxide and breathe out oxygen gas. In addition to this, they also breathe as animals do, to a slight extent, taking in oxygen and breathing out carbon dioxide. This action is more pronounced in darkness.

Conservation

The wonderful principle called conservation is illustrated by what we know of plant life. Plants in growing store up energy derived from the heat and light of the sun. When they decay, or are burned, or are eaten by animals, exactly the same amount of energy is set free and changed into a new form, and just as much carbon dioxide as the plant breathed in, is given back to the air. A plant which was many

years in growing may be consumed in an hour or may decay slowly for years. In either case the same total amount of energy is set free, fast or slowly. This energy is most apparent as heat. In the growth and destruction of the plant both energy and matter have been transformed, but neither energy nor matter has been made or lost—it has merely taken on a new appearance. When animals feed on plants they transform the energy of sunlight which is stored up in the plant into energy of vitality. In this sense man and all animals are "children of the sun."

CHEMICAL TERMS.

To explain various chemical and physical phenomena the scientists consider that matter consists of certain small molecules and atoms.

If a drop of water be divided and sub-divided indefinitely, it is conceivable that a point would come when it could not be divided further by physical means. This final bit of water is called a molecule. It would be far from visible by the most powerful microscope. From calculation which we will not go into, we learn that a few hundred million ordinary sized molecules would cover the space of a pin head.

Molecules

If the water is broken up by some powerful force as by the electric current, we have seen that two different substances are obtained—oxygen and hydrogen. Consequently the molecules of water must have been made up of other still smaller particles and these are called atoms. The atoms of a chemical element, then,

are of the same kind, for from an elemental substance like oxygen, only oxygen can be obtained by any means now known.

Atoms

The atoms may be likened to the letters of our alphabet and the molecules to the words. From a few different kinds of atoms (letters) can be made a great variety of molecules (words).

TABLE OF COMMON ELEMENTS.

Aluminum	Al	Iodine	I	Oxygen	O
Arsenic	As	Iron (Ferrum)	Fe	Phosphorus	P
Barium	Ba	Lead (Plumbum)	Pb	Silicon	Si
Boron	B	Magnesium	Mg	Silver (Argentum)	Ag
Calcium	Ca	Manganese	Mn	Sodium (Natrium)	Na
Carbon	C	Mercury (Hydrargyrum)	Hg	Sulphur	S
Chlorine	Cl	Nickel	Ni	Tin (Stannum)	Sn
Copper	Cu	Nitrogen	N	Zinc	Zn
Gold (Aurum)	Au				
Hydrogen	H				

The atoms of an element are all exactly alike. They weigh the same and act the same whatever their source. Two or more atoms of an element may combine to make a molecule of that element. The molecules of a chemical substance are always composed of the same number and kind of atoms.

Chemical Signs

To express the composition of substances chemists have made use of certain abbreviations and signs. To indicate an atom of hydrogen the letter H is used and for oxygen, the letter O, for nitrogen, N, and so on as shown in the table.

When expressing a compound the number of atoms is indicated by sub-script; for example, H_2 means two

atoms of hydrogen; H_2O expresses two atoms of hydrogen and one atom of oxygen, and as we have found, this is the composition of water; so H_2O is the chemist's short way of indicating water. These are called chemical formulas. The formula for sulphuric acid is H_2SO_4. This indicates that it is made up of two atoms of hydrogen, one atom of sulphur, and four atoms of oxygen. The following table gives the chemical formulas of many of the chemical substances found in the household.

Expressing Molecules

THE HOUSEKEEPER'S LABORATORY.

All modern science is based upon experiment. Chemistry was hardly a science until experimental research began. It must be confessed that the average housewife seldom thinks of making experiments. She is apt to remain helpless before any new problem of the home without printed directions or advice from friends. Very often the easiest and surest way to find out a thing is to *try it*. Use your kitchen as a laboratory. It would, of course, be most unwise to make experiments on expensive materials. For example, if a stain was to be removed from colored goods, it would be best to find the effect of the chemicals to be used on some small piece of the fabric.

Experiments

To test the color of a sample of gingham for fastness in washing, try a part of the sample in soap and hot water and see if the color "runs" or stains the water. Dry and iron the piece treated and compare with the portion of the original sample kept. A sample can be

Testing Colors

TABLE OF COMMON SUBSTANCES AND THEIR FORMULAS.

SUBSTANCE	FORMULA	SUBSTANCE	FORMULA
Water	H_2O	Calcium Oxide (Lime)	CaO
Peroxide of Hydrogen	H_2O_2	Lime Water	$CaOH$
Sulphuric Acid	H_2SO_4	Calcium Carbonate	$CaCO_3$
Sulphur Dioxide	SO_2	Calcium Hypochlorite (Chloride of Lime)	$Ca(ClO)_2$
Hydrochloric Acid	HCl	Sodium Thiosulphite ("Hypo")	$Na_2S_2O_3$
Acetic Acid	$C_2H_4O_2$	Cane Sugar	$C_{12}H_{22}O_{11}$
Tartaric Acid	$C_4H_6O_6$	Milk Sugar	$C_{12}H_{22}O_{11}+H_2O$
Cream of Tartar (Acid potassium tartrate)	$KC_4H_5O_6$	Grape Sugar	$C_6H_{12}O_6$
Carbon Dioxide	CO_2	Starch	$(C_6H_{10}O_5)x$
Carbon Monoxide	CO	Cellulose	$(C_6H_{10}O_5)y$
Caustic Soda	$NaOH$	Stearine (in fat)	$C_3H_5(O_2C_{18}H_{35})_3$
Caustic Potash	KOH	Palmitin (in fat)	$C_3H_5(O_2C_{16}H_{31})_3$
Sodium Carbonate (*Anhydrous*)	Na_2CO_3	Soap	$NaO_2C_{18}H_{35}$, $NaO_2C_{16}H_{31}$, etc.
Sodium Carbonate (*Crystalline*) (Washing Soda)	$Na_2CO_3+12H_2O$	Albumen	(*Not definitely known.*)
Sodium Bicarbonate	$NaHCO_3$	Alcohol	C_2H_5OH
Ammonia (*gas*)	NH_3	Wood Alcohol	CH_3OH
Ammonium Hydrate (Ammonia Water)	NH_4OH	Glycerine	$C_3H_5(OH)_3$
		G'soline, N'phtha	C_6H_{14}, C_7H_{16},
		Benzine, etc.	C_8H_{18}, etc.

tested for fastness to light by exposing to direct sunlight for a day or two, saving a portion of the cloth as before for comparison. If the dye will stand direct sunlight without appreciable change for this length of time, it will not give much trouble by fading. Wall paper may be tested for fading in a similar way.

Testing by Comparison

The industrial chemist always endeavors to test materials in a manner as nearly like the way they are to be used as possible. For example, if he were testing two samples of flour to be used for making bread, he might make up two small loaves, using carefully weighed quantities of each sample of flour and other materials and baking the loaves at one time, compare the result. In such cases it is usual to have a "standard" flour or other material to use for comparison.

This method of testing by comparison could often be used by housekeepers provided reasonable care were taken as to weights and conditions. Working thus, flour, baking powder, soap, spices, flavoring extracts, in fact almost all the raw materials of the kitchen and laundry could be tested.

House hold Chemicals

The chemicals for household use are chiefly acids, alkalies, and solvents for grease. Acids and alkalies are opposed to each other in their properties and if too much of either has been used, it may be rendered innocent or neutralized by the other; as when soda has turned black silk brown, acetic acid or vinegar will bring the color back.

Acids for the Laboratory

The acids which should be on the chemical shelf for the household are acetic, hydrochloric (muriatic), oxalic. Vinegar may be used in many cases instead of acetic acid, but vinegar contains coloring matter which stains delicate fabrics and it is better to use the purified acid. Hydrochloric and oxalic acids are strong acids and will harm most household materials if allowed to act for *long time*. Acetic acid is a weak acid and as it is volatile, evaporates without becoming concentrated as do the others.

Some bright blue flannels and other fabrics, when washed with soap or ammonia become changed or faded in color. If acetic acid or vinegar be added to the last rinsing water, the original appearance may be restored. Not all shades of blue are made by the same compounds, hence not all faded blues can be thus restored.

Care of Chemicals

The use of these acids has been indicated in the previous pages, and there remains to be considered, only certain cautions. *Hydrochloric acid* is somewhat volatile. It will escape even around a glass stopper and will eat a cork stopper; therefore, either the glass stopper should be tied in with an impervious cover—rubber or parchment—or a rubber stopper used, for the escaping fumes will rust metals and eat fabrics.

Oxalic acid should be labeled POISON.

The bleaching agents, "*chloride of lime*" and *Javelle water* owe their beneficent effect to substances of an acid nature which are liberated from them. They

should all be used in solution only, and should be kept in bottles with rubber stoppers.

Sulphurous acid gas, obtained by burning sulphur, will often remove spots which nothing else will touch. The amount given off from a burning sulphur match will often be sufficient to remove from the finger fruit stains or those made by black kid gloves.

The alkalies which are indispensable are: Alkalies

1st. *Ammonia*—better that of the druggist than the often impure and always weak "household ammonia." The strong ammonia is best diluted about one-half, since it is very volatile, and much escapes into the air.

2nd. *Potash* and *Caustic Soda*, which are to be had at the grocers in small cans. The lye obtained from wood ashes owes its caustic and soap-making properties to potash. The caustics are corrosive in their action, and must be used with discretion.

Crystallized sodium carbonate, the sal-soda of the grocer, is chemically speaking a salt and not an alkali, but it gives all the effect of one, since the carbonic acid is so weak that it readily gives place to other substances.

Sal-soda is a very cheap chemical, since it is readily manufactured in large quantities, and forms the basis of most of the washing powders on the market. With grease, it forms a soap which is dissolved and carried away.

3rd. *Borax* is a compound of sodium with boric acid, and acts as a mild alkali. It is the safest of all the

alkalies, and affects colored fabrics less than does ammonia.

Solvents

Solvents for grease are alcohol, chloroform, ether, benzine, naphtha, gasolene—all volatile—kerosene and turpentine. Of these chloroform is the most costly, and is used chiefly for taking spots from delicate silks. Fabrics and colors not injured by water may be treated by alcohol or ether. Benzine, naphtha or gasolene are often sold, each under the name of the other. If care is taken to prevent the spreading of the ring, they can be safely used on any fabric. They do not mix with water, and are very inflammable.

The less volatile solvents are kerosene and turpentine. Kerosene is a valuable agent in the household, and since some of the dealers have provided a deodorized quality, it should find an even wider use. The lighter variety is better than the 150-degree fire test, which is the safe oil for lamps. As has been indicated in the preceding pages, the housewife will find many uses for this common substance.

On account of the purity and cheapness of kerosene, turpentine is less used than formerly, although it has its advantages.

Closet for Chemicals

These household chemicals should have their own closet or chest, as separate from other bottles as is the medicine chest, and especially should they be separated from *it*. Many distressing accidents have occurred from swallowing ammonia by mistake.

In addition to these substances, certain others may be kept on hand, if the housewife has sufficient chemical

knowledge to enable her to detect adulteration in the groceries and other materials which she buys.

A few of these simple tests are given with the chemicals needed. Tests

Directions for Using the Housekeeper's Laboratory.

When directed to make a solution acid or alkaline, always test it by means of the litmus paper:

Blue turned to red means acid. Red turned to blue means alkaline.

Only by following the directions can the test be relied upon. Under other circumstances than those given, the results may mean something else.

Use the acids in glass or china vessels only. Metals may be attacked. Do not touch brass with ammonia or marble with acid. Aluminum is quickly corroded by the alkalies. Vessels

Heating or burning a substance often gives evidence of its character. Organic solids will char, leaving charcoal (carbon) when heated and will disappear completely when burned. Some salts melt; others do not.

All the carbonates that the housewife is likely to meet will give an effervescence of carbon dioxide with muriatic acid and most of them with acetic acid. Carbonates

Substances of an acid nature will effervesce with a solution of cooking soda. The test will be more delicate if the solutions are warm.

To test for *sulphuric acid* or soluble *sulphate* in soda, cream of tartar, baking powder, vinegar, sugar or

syrup: Add muriatic acid to the solution (if the insoluble part is sulphate of lime, it will dissolve in the acid on heating), then add barium chloride. A heavy white precipitate proves the presence of sulphuric acid, either free or combined. If the solution is not distinctly acid at first, it is not free.

Lime Test

To test for *lime* in cream of tartar, baking powder, sugar or syrup: Make the solution alkaline with ammonia and ammonium oxalate. A fine white precipitate proves the presence of lime. Good cream of tartar will dissolve in boiling water, and will show only slight cloudiness when the test for lime is applied.

Phosphates

To test for *phosphates* in cream of tartar or baking powder: Make acid by nitric acid, and add ammonium molybdate. A fine yellow precipitate or yellow color proves the presence of phosphates.

Chlorides

To test for *chlorides* in soda, baking powder, sugar, syrup or water: Make the solution (a fresh portion) acid with nitric acid, and add silver nitrate. A white curdy precipitate or a cloudiness indicates chlorides.

Ammonia

To test for *ammonia* in baking powder: Add a small lump of caustic soda to a strong water solution. Red litmus will turn blue in the steam, on heating.

Alum

To test for *alum* in cream of tartar, baking powder or bread: Prepare a fresh decoction of logwood; add a few drops of this to the solution or substance, and render acid by means of acetic acid. A yellow color in the acid solution proves absence of alum. A bluish

or purplish red, more or less decided, means more or less alum.

Starch

To test for *starch* in any mixture which has been cooked, simply moisten with dilute tincture of iodine such as is kept by the druggists. An intense blue color will show the presence of even a minute quantity of starch. If the substance has not been heated, boil a portion and *let cool* and then test with a few drops of iodine solution. Heat destroys the blue color of iodine with starch and therefore the test must be made in cold solutions.

Washing Powder

If the label of a washing powder claims it to be something new, and requires that it be used without soda, as soda injures clothes, it can be tested as follows: Put half a teaspoonful of the powder into a tumbler, add a little water, then a few drops of muriatic acid. A brisk effervescence will prove it to be a carbonate, and if the edge of the tumbler is held near the colorless flame of an alcohol lamp, the characteristic yellow color of sodium will appear and complete the proof. If the acid is added drop by drop, until no more effervescence occurs, and there remains a greasy scum on the surface of the liquid in the tumbler, the compound contains soap as well as sal-soda, for the acid unites with the alkali of the soap and sets free the grease. Acetic acid or a solution of oxalic acid may be used in place of the muriatic acid.

Silver Polish

If some very costly silver polishing powder is offered as superior to all other powders, a drop or two of

muriatic acid or of warm vinegar will decide whether or not it is chalk or whiting by the effervescence or liberation of the carbonic acid gas.

Sample Tests

In making all the foregoing tests, it is well to observe the effect of the chemicals used on the substance to be tested for, and so become familiar with the characteristic color or appearance of the test. For example, before testing a washing powder, add a little acid to a soap solution and observe the greasy film produced, and in testing for alum add a very little alum solution to some flour and test with the logwood solution, noting the color given. This procedure will lead to more reliable results.

Caution! Use a new solution of a fresh portion of the first one for each new test and follow directions exactly. This is essential to remember.

CHEMISTRY OF THE HOUSEHOLD.

PART III.

Read Carefully. Place your name and address on the first sheet of the test. Use a light grade of paper and write on one side of the sheet only. *Do not copy answers from the lesson paper.* Use your own words, so that your instructor may know that you understand the subject. Read the lesson paper a number of times before attempting to answer the questions.

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1. What properties of "cream of tartar" make it suitable for baking powder?
2. Explain how a candle is a gas factory.
3. What conditions must be present for an explosion to take place?
4. What is "cooking soda?" How does it differ from washing soda?
5. What is the principle of the Davy safety lamp?
6. Describe the manufacture of coal gas.
7. How is water gas made? What objectionable features has it?
8. What is "quick lime" and what are its uses?
9. How is electricity produced in a voltaic cell?
10. What does the chemical formula H_2SO_4 indicate?

11. How is "conservation" illustrated in the life and decay of a tree?

12. What can you say about the advisability of the housekeeper making experiments?

13. How would you test for a carbonate? How for an acid without using litmus paper?

14. How are tests made by comparison?

15. Are there any questions you would like to ask relating to "A Day's Chemistry"?

16. Have you any personal experience, original method, or new fact to offer, relating to the subjects taken up in the lesson on the "Chemistry of the Household" that would be of interest to your fellow students?

Note — After completing the test, sign your full name.

SUPPLEMENT

CHEMISTRY OF THE HOUSEHOLD

By Margaret E. Dodd, S. B.

In reading many hundreds of test papers written by our students I have found that additional comments suggest themselves frequently, and it may be of interest to bring them together here.

IMPURITIES IN WATER

By the term impurities, we mean substances out of place. Pure water is oxide of hydrogen, H_2O. If water has salt dissolved in it, for instance, the salt is an impurity for the water, though we do not think of salt as being an impure substance in itself. The mineral impurities in drinking water are seldom a source of danger, although if the amount is large, such water may not "agree" with persons not used to it. Mineral impurities will usually make the water hard, and therefore troublesome for laundry work and to some extent in cooking.

LAUNDRY WORK

Satisfactory water for laundry work must not only be clear and soft but it must be free from iron, from the discoloration due to decaying vegetable matter, clayey soil, and so on. It should also be free from any odor when hot. Muddy water may be cleared more

or less satisfactorily by filtering it through sand or "by precipitation." In the latter method, dissolve a scant tablespoonful each of alum and borax in a little hot water, and add this amount to each gallon of water used, stirring it in, and allowing it to settle. The alum and borax react to form a cloudy substance which settles to the bottom, carrying the mud with it. The clear water must then be carefully poured or dipped off from the sediment. A siphon is an excellent contrivance for such a use. If a piece of garden hose is used, tie on a piece of wood so that it extends one or two inches beyond the end, to keep it above the sediment. Weight it with a piece of lead.

When water made hard by carbonate of lime is to be softened, addition of any of the alkalis will soften it, for this reason. These carbonates will not dissolve in water unless it contains carbon dioxide gas in solution. The alkalis added, unite with the gas, and the lime is thereby made insoluble and separated from the water. We do not see it as a rule, for there is in reality, very little of it, and this little separates in very tiny particles. Water which is hard in the clothes boiler frequently causes trouble because of tiny bits of lime which separate from it and make spots upon the clothes.

A spring situated in sandstone rock generally yields soft water because the sandstone is so slightly soluble, but one situated in limestone rock always gives hard water. Limestone is a very common rock,

so many springs are of hard water. A shallow well is more apt to yield soft water than a deep one is, and a river has clearer and softer water near its source, where it runs over rocks, and through uncultivated land.

Occasionally where free alkali is added to hard water, it unites with greasy or oily matter in the garments being washed, and forms dark spots of soap insoluble in water. This is prevented to some extent by addition of a very little turpentine, and boiling such spotted garments in clean suds may dissolve out the stains if they have formed. This happens so seldom that the use of soda in laundry work (with caution) for softening water is still to be recommended

Washing powders are usually composed for the most part of washing soda, and as they cost more than soda, it is rather better to buy the latter. Moreover, the strength of the alkali may be more accurately judged.

Water varies greatly in hardness, so it is difficult to give exact rules for softening it, though I am often asked for them. In general, for moderately hard water use:

1 level tablespoonful of sal soda to 1 gallon water.

½ level tablespoonful of powdered lye to 1 gallon water.

1 level tablespoonful of borax to 1 gallon water.

Do not use ammonia with very hot water, for heat liberates the ammonia gas, which is thus lost.

Some students have thus described the use of ashes from hard wood:

Add a quart or more of water to a quart of ashes. Boil it a few minutes, adding more water if necessary. Then add sufficient water to make a gallon. Let it settle, then pour off the water and strain it. Put enough of it in the wash water to secure a good suds with soap. The water dissolves the potash (potassium carbonate) from the ashes. So this is an economical method of getting this alkali.

I have had many interesting letters on the subject of laundry work. Some of the processes described may be new to many of our students.

One writer describes a method of using paraffine in washing. She dissolves a bar of soap in boiling water and adds to it a piece of paraffine almost as large as a walnut. She uses this in making a suds with *boiling* water in which the clothes are thoroughly boiled for twenty minutes or more, punching them ocassionally. They must be rinsed in several hot waters to ensure the removal of the paraffine, but she claims the clothes will be beautifully white.

A number have advocated the use of kerosene in laundry work, especially with very much soiled articles. Both this and paraffine certainly act upon the oily film which entangles the dirt and thus make the washing easier. The objection to their use is that more

soap and more hot water and therefore more fuel must be used. Two tablespoonfuls of kerosene in a boiler of soapy water is about the right quantity. In this connection it should be said that when clothes are taken from the boiler, they should be put into tepid water, and pushed well into it, for lying in the air seems to set the dirt, probably because the fibres contract as they cool, so that foreign particles are enclosed in the cloth and cannot fall out into the rinse water.

Kerosene is excellent to use in washing dish towels. Make a strong soap suds, putting in a tablespoonful of oil to a gallon of water. Soap the towels well. and boil them in this suds for half an hour or so. Then wash, rinse and dry them, in the fresh air. Kerosene is somewhat volatile, and its odor will escape in time. When kerosene has been used, the wringer, tubs, etc., will need very careful cleaning to remove any film of oil before it has time to catch dust.

BLUING

There are three kinds of bluing now on the market. The action and disadvantages of Prussian Blue have been described. It gives a better color, however, than either of the other two . A second kind is Ultramarine blue. This, also, is an iron compound, but it does not decompose with alkali. It is what we often buy as the "ball bluing," and is insoluble in water. Water, however, causes it to break up into very

minute particles which spread through the liquid and give it a blue color. The water must be kept stirred, and one must be careful in using it that the clothes do not get streaked. The balls of bluing should be tied up in a cloth and washed from this into the water. It is well to prepare it in a separate dish and then add it to the water. Indigo blue is easier to use, but does not give so good a color. Preparations of indigo for laundry work may still be obtained.

Here is a method of cleansing knitted worsted goods which was strongly recommended. Wash the garment in gasoline, and allow it to dry. Then shake it well in a tight box with flour or fuller's earth, allowing it to remain there an hour or more. The powder will absorb any greasy or oily substance, and later may be shaken out. In using gasoline for cleaning in this way, have a generous amount, and allow for rinsing the articles well. The gasoline may be used more than once, for the dirt which it contains will settle to the bottom of the vessel in which it stands and the clear liquid may be poured off. Use it out of doors, or in a strong outward draft, that the inflammable vapors it produces may blow harmlessly away.

To many people, the word "chemical" always means an *acid*. Now, acids and alkalis differ so much in their properties, that it is wise to be able to distinguish between them. Injuries due to the use of one may frequently be remedied by prompt use of the

other. Alkalis are especially useful in laundry work because of their action upon grease of most kinds. Some of the salts formed with the alkali metals are alkaline in reaction. Among these are washing and cooking soda.

HOME SOAP MAKING

All fats and oils are compounds of certain fatty acids combined with glycerine. Glycerine is easily separated from this combination by strong alkalis, and thus soaps are made. The glycerine is a by-product in many soap factories, but it is not evident in home-made soap, being thrown away with any waste water, or, perhaps, left in the soft soap. The various fats are composed of different kinds of fatty acids, so we have varieties of soap made from them.

Rosin acts like fatty acids, for it is able to combine with alkali to make rosin soap. This is good for rough work, but it is apt to separate in hot water, setting free the rosin acids, which may settle upon the fabric being washed, giving it the odor of rosin or causing it to become yellow. It is very objectionable when the clothes come to be ironed. This rosin also makes fabrics likely to take up dust. If the clothes are well rinsed, the amount of rosin soap in ordinary yellow soap gives no trouble.

I have often been asked for a recipe for home-made soap, and, too, I have had many students write me of their success in this process. Many housekeepers

keep and clarify the fats from food. Soap may easily be made from this, as follows:

Take a pound can of lye (Babbitt's potash is good) and dissolve it in three pints of cold water. It will become quite hot as it dissolves, and care must be taken in adding the lye to the water, as it is apt to spatter, and is likely to irritate the hands.

Have ready five pounds of clean fat, which has been melted and strained through cheese-cloth to remove all specks of brown. When the lye is cool, pour it slowly on the grease, stirring it with a stick until the two mix, and the liquid becomes about as thick as honey. Too long stirring may cause the ingredients to separate.

Mould the soap in agate or wooden trays. If a wooden box is used, it should be lined with several thicknesses of wrapping paper. The layer next the soap should be oiled. The soap should harden in a moderately warm place, and then may be cut into cakes. This is the so-called "cold process" soap. It will not be suitable for fine work but improves with age.

Several students have described to me how they remembered seeing soap made at home from alkali obtained by leaching wood ashes. The ashes were put into a large box pierced with holes, the box placed over the soap kettle, and hot water was poured upon the top. This alkali would make soft soap, which would be stored in barrels. If hard soap were desired, salt was added to some of the soft soap.

A reaction takes place by which some of the sodium in the salt is combined with the fatty acids, sufficient hard soap being formed to harden the mass. Nowadays, even when we buy "potash" we are quite sure to find that we can make hard soap, for it almost always is chiefly soda (caustic soap).

Washing soda has a great many uses, and I am frequently reminded of new ones by our students. I am told how excellent it is to put a little in water and boil this in the cooking dishes on which food has hardened or burned. Another describes how she cleans silver by boiling it with a little soda, then rinsing it in very hot water and drying quickly and thoroughly. The wife of a dairy farmer assures me that she could never get her creamery cans suitably clean without plenty of sal soda, which quickly removes the butter fat. When we use it in laundry work, however, we must remember that, like other solids, when it dissolves, a saturated solution forms around each piece, and this strong solution may injure anything on which the pieces rest. Therefore the crystals should always be dissolved, and the solution diluted as much as may seem necessary.

DISH WASHING

The washing of dishes takes so much time in every house that it is evidently a subject calling for close attention. Nothing is more desirable than that this work be done thoroughly and well; still, it is doubtless

possible to plan for it in such a way that time may be saved for other matters.

In the first place, systematic work is sure to go more rapidly than haphazard fashions. The dishes should be prepared for washing by scraping them as clean as possible, and some housekeepers advocate rinsing off many of them under the hot or cold water faucets before putting them in the dish-pan. Hard water is very unsatisfactory for dish washing, and the use of soda or borax is a great help when soft water is not available. Borax is not so hard on the hands as soda. Dishes which have contained milk or eggs are better rinsed well in cool water, for heat hardens the albumins so that they are removed with difficulty.

Plenty of hot, soapy water is necessary to do this work easily, and a second dishpan of clear, hot water in which to rinse the dishes is a great help. Use very little soap on gilt china, however.

There seems to be a great variety of opinion on the subject of washing glass. Many housekeepers have expressed a preference for washing it in cold water rather than in hot. Where the glass is not at all greasy, this is very well. Ammonia or soda in the water helps to clean the glass and makes it lustrous. Glass washed in cold water should be allowed to drain almost dry before it is polished.

One housekeeper has described to me a wire basket which she has had made to hold dishes when they

drain, and which is made to fit into her dishpan. Fitting the dishes into this, she is able to immerse them in hot rinsing water, and then lift them out to dry. She finds the plan an excellent one.

Another student writes that she has found sifted coal ashes a most useful article to use in cleaning knives. Another prefers sifted wood ashes. These most be very carefully sifted, so that no hard bits be left in, which might scratch the articles polished.

The kitchen dishes are usually the most difficult to wash, and one student describes a home-made "scrubber" which she declares is very useful. "Take a broom apart, a good one, by removing the wire and letting the straw loose," she says. "The upper part of the straw is then put into boiling water and left long enough to soften it. Then the straws are tied together in bundles about two inches across, using a strong twine. The twine is pulled tight, and sinks into the softened straw, and when dry, it does not slip. A loop is left for hanging the bundle, and the straw is left its whole length. These are so long and slender they will reach into anything. They are a great saving on the hands, and allow the use of much hotter water."

Many of our students recommend the use of soft paper in cleaning greasy dishes, kettles, and pans, The papers may be burned, thus disposing of much grease which would otherwise find its way into the kitchen sink drain.

LATENT HEAT

The subject of latent heat, described on page 12, has proved very puzzling to many. It is certainly a strange idea at first, that heat does anything more than make things *warm*. Still, a moment's consideration recalls to mind that heat can do many other things. Heat causes chemical change, for substances are often changed by strong heat. Heat causes most substances to expand. If a sealed can of any substance is strongly heated, it will probably explode. Heat causes liquids to evaporate, and solids to melt.

If a liquid is placed in an open dish on a source of heat, its temperature will rise until it begins to boil. After this, it gets *no hotter*, no matter how much heat is applied, unless the liquid is becoming more dense as it boils, as would be the case with a syrup, for example. The heat it receives is all expended in changing the liquid into vapor, or, as we say, changing the "state of matter." The particles (molecules) are driven farther apart by the heat. A cubic inch of water makes a cubic foot of steam. The amount of heat necessary to produce the change from liquid to gas varies with different substances. Water requires a very large amount. Four times as much heat is required to change an ounce of water into steam as to vaporize the same amount of alcohol. If heat is applied rapidly, the liquid will boil rapidly, but it does not affect the temperature. The heat

used in this way is not lost, but is stored up in the vapor as latent heat. The steam is no hotter than the boiling water, and heat added keeps it from becoming liquid. When vapor condenses and changes back to liquid, the latent heat is given out, and warms surrounding things. In fact, the vapor cannot condense unless the latent heat it contains is removed, except under pressure. This latent heat makes steam an excellent medium for heating buildings, as it contains so much heat and passes through pipes rapidly. Not only is the steam itself hot, but it carries a vast amount of heat stored up, to be liberated in the cooler regions.

Latent heat is stored up in water, also, and is liberated when the water becomes ice. This is seldom apparent, for far less heat is thus stored in water than in steam, and, too, the temperature of freezing water is low. The heat given out when water freezes is at 32° F, while that given out when steam condenses is at 212° F. Still, a cellar may be several degrees warmer if it contains a tank of water which freezes than if the water were not there. The temperature may keep about 32° F. where otherwise it might go to 26° or less.

A room is cooled in warm weather by sprinkling water upon the floor. The evaporation of the water takes much heat from the air, storing it in the

vapor produced. Britannia and some other metals of which pitchers, teapots, etc., are made will melt if placed on a hot stove. If, however, they contain water, this is not likely to occur, for the water cannot be heated above its boiling point, and this is far below the melting point of the metal, and keeps the temperature of the metal low enough for safety. This reminds me of an experiment I once saw where candy was actually made in a pasteboard box. The syrup never became hot enough to scorch the paper, and thus the paper itself was kept fairly cool.

USE OF THE THERMOMETER

A kitchen thermometer may be bought of any dealer in the better class of kitchen goods. The floating dairy thermometers are convenient. One to register 212° F, may be obtained from the School for 50 cents. A thermometer made to register oven temperatures is more expensive, one registering to 600° F. costing $1.50. Various uses of the thermometer are described in *Principles of Cookery* and *Home Care of the Sick*, but there are many times in the kitchen when it is of assistance, as in getting the right density for syrups in candy making, for syrups in preserving, and the right temperatures for raising bread, making soups, custards, etc.

Some uses of the thermometer in the kitchen are the following, described in Miss Parloa's "Home Economics":

Olive oil is liquid above 75°. If above this temperature it shows solid specks, making it look cloudy, you may be sure it is adulterated with some fat having a higher melting point.

Butter should melt at 94°. If it does not, you may know it is adulterated with suet or some other fat having a higher melting point.

BREAD MAKING

The composition and manufacture of bread are subjects which have been given much study. The carbon dioxide which serves to lighten the dough raised with yeast is produced at the expense of some of the starch of the flour. This starch is completely driven from the loaf as carbon dioxide gas and alcohol during the baking. The loss is estimated at about 2 per cent. Attempts have been made in large bakeries to save the alcohol, but no economical method has been devised. About fifty years ago, German chemists in studying the question estimated that the food materials lost in twenty-four hours, when bread is raised with yeast, was sufficient to supply bread to 400,000 people! These figures were certainly startling to the thrifty Germans, and the possibility of producing the carbon dioxide gas in some less extravagant manner was studied with considerable care in German laboratories, and also at Harvard University in America. Baking

powders are the result of these investigations Gluten is not changed chemically by the action of the yeast or of the carbon dioxide, but it is physically changed—the escape of the gases stretching it out into fibres. Gluten, like other proteids, hardens when heated. Baking thus makes the porous condition of the dough permanent.

MAKING BAKING POWDER

Several students have sent me recipes they like to use for making baking powder. The claim is made that these cost rather less than the kinds that can be bought, and also that they are much more effective. Here is one:

½ lb. cream of tartar.
¼ lb. cooking soda (bicarbonate of soda).
⅛ lb. corn starch.

The best quality of each must be bought. Sift them together at least a dozen times, the last time into baking powder boxes. Be careful to seal up all cracks by pasting over them paper strips. About one half as much of this is required as for the average powder sold.

These proportions would probably give a slight excess of acid. We might combine 2¼ parts of the acid salt with one part of soda if our salts are chemically pure. The corn starch is added to keep the soda and acid salt from forming quite such an intimate

mixture. The two salts in contact would very slowly combine, and the baking powder thus lose its strength. .

DISTILLATION

A few more words might be said on the subject of distillation. I am sometimes asked to explain more fully the term "destructive distillation." When a complex substance like wood or coal is heated some of its ingredients are made volatile at the high temperature, and so escape as gases. The wood itself is broken up into simpler substances. It is plain that in this process the original substance is lost *as such*, new substances taking its place, and we therefore speak of the process as *destructive* distillation.

When water containing various salts or gases in solution is heated, the gases will be given off as the temperature rises. At the boiling point, the water itself will begin to pass off as vapor. The salts will not vaporize unless much more strongly heated. If the steam be collected and cooled, it will condense to form pure water. This in an illustration of *simple* distillation. If a mixture of alcohol and water be heated some of the alcohol will vaporize before the water. It may in this way be separated from the water, and this process is called *fractional* distillation. This is the principle employed in the manufacture of whiskey, etc.

COMPOSITION OF GAS

The complex nature of coal gas is shown by the following table, which represents an average sample:

Hydro-carbon vapors	0.6
Heavy hydro-carbons	4.4
Carbon dioxide	3.4
Carbon monoxide	10.0
Methane (CH_4)	30.6
Oxygen	0.3
Hydrogen	45.9
Nitrogen	4.8
	100%

Of these, the hydro-carbons, carbon monoxide, CH_4 and hydrogen are combustible.

Coals always contain more or less sulphur, which is a great trouble to the gas manufacturer. It frequently happens that some of it gets into the gas. If such gas escapes, the sulphur compounds unite with the silverware, giving is a coating of dark sulphide of silver. If silver tarnishes quickly, it is an indication of a leak of gas or sewer gas. It is estimated that a ton of coal should yield 10,000 feet of gas, 1,400 lbs. of coke (35 bushels), 12 gallons of tar, 4 lbs. of ammonia.

More than six hundred products are obtained from the coal tar. The nature and uses of these products would form an interesting topic for futher study.

The composition of water gas is somewhat as follows:

Hydro-carbon vapors	1.2
Heavy hydro-carbons	12.0
Carbon dioxide	3.0
Carbon monoxide	28.0
Oxygen	0.4
Hydrogen	31.4
CH_4 (Methane)	20.8
Nitrogen	3.2
	100%

Notice that this gas contains less methane and hydrogen (which are combustible), and their place is taken by carbon monoxide, which, although combustible, is very poisonous. There is some carbon monoxide in ordinary illuminating gas but not nearly so much. The water gas has a strong odor from the hydro-carbons (crude gasoline) added to make it luminous, but comparatively little of it in the air is likely to produce very injurious effects upon living things, plants and animals alike. It is the most poisonous substance that comes into the house. It is estimated that about fourteen per cent of the gas manufactured escapes into the earth through leaky gas mains. In passing through the soil the odorous part of water gas may be strained out, so that it becomes odorless. Whole families have been poisoned from deodorized water gas leaking into the house by way of

the cellar. This emphasizes the importance of having a perfectly tight cellar, with cemented walls and floor, and the importance of ventilating the cellar, for the cellar air finds its way to the rooms above.

Natural gas contains practically no carbon monoxide.

SPONTANEOUS COMBUSTION

We often hear of fires apparently "starting themselves." Such cases are due to accumulation of heat produced by slow oxidation. If a pile of oily rags, cotton waste, etc.,be allowed to stand for a time, the oily matter will begin to combine slowly with oxygen. This may occur in the inner part of the heap, and the outer layers retain the heat until, perhaps, the kindling point of some of the inflammable oils is reached, when the whole mass will burst into flame. This is much more likely to happen with linseed oil and certain other vegetable "drying oils," as they unite readily with oxygen, and so become hard and varnish-like. The mineral oils (paraffine oil) do not combine with oxygen at ordinary temperatures, and probably will not cause spontaneous combustion. Still, all oily cloths should be burned or disposed of in some safe fashion.

CONSERVATION OF ENERGY

An interesting and important principle, explained on page 23 of Part I, and again on page 110 of Part III, is Conservatism. This principle has been established by countless experiments, but it is not

one that the housekeeper can well investigate. It is, however, one she must continually bear in mind. Matter and energy can never be *created* or *destroyed*; both may be transformed, and may therefore appear in many different ways. The voltaic cell is a simple device for transforming chemical energy into electrical force. The chemical affinity of two substances causes them to unite under the right conditions. This union results in the liberation of energy, which may appear as heat, light, or electricity. When coal and oxygen unite, we get both heat and light as a result. Chemical union usually produces heat.

The energy of our bodies we get *solely* from the food we absorb. We should eat such foods as best give us the needed energy, and we should learn to expend this energy wisely, as we have but a limited amount of it. One student wisely comments upon this, as follows:

"In the economic plan of housekeeping, it would be well if each one would endeavor to realize that she is a part of the machinery of the household, and that to be continually on the move is as disastrous to the equilibrium of the home as it is to rust, as it were, for want of use. A given amount of rest each day is a true part of economy. Then, too, in the daily regime, there are ways and ways of doing things. Always choose the easiest, if it conflicts not with the quality of the work done. For example, do not stand while paring potatoes, apples, etc. It is just

as easy to do this work sitting, and you can then get some rest at the same time. Don't worry—to worry is a very extravagant thing, for it uses up valuable force, and does no good at all."

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Note.—For the *free* bulletins, send to the Department of Agriculture, Washington, D. C.; to obtain the *for sale* bulletins, send coin or money order to the Superintendent of Documents Washington, D. C.

SUPPLEMENTAL PROGRAM ARRANGED FOR CLASS STUDY ON

CHEMISTRY OF THE HOUSEHOLD

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As in the study of chemistry and physics so much emphasis is placed on laboratory work, the following supplementary program is made up chiefly of simple experiments, such as may be performed with little or no apparatus. When heat is required, it may be supplied by a small gas stove, a one burner oil stove, or an alcohol lamp. The lamp of a chafing dish might be used. A thermometer will be loaned by the School for 6 cents postage, or one may be purchased for 50 cents.

MEETING I

(Study pages 1–29)

Water

To show that ordinary water has gases dissolved in it. See experiment on page 2. The gas dissolved in water is not exactly of the same composition as air. It usually contains more oxygen and more carbon dioxide than ordinary atmospheric air, varying somewhat with the sources of the water. This dissolved gas enables fish and other marine animals to live. A fish cannot live in water that has lost its dissolved air by being boiled. It is drowned just as human beings are, because of lack of oxygen.

Water of Crystallization

Make crystals as described on page 5. A certain definite amount of water is present in the crystals which varies with each substance. Clear crystals are pure or nearly so. The "mother liquor" remaining after the crystals are formed

contains most of the impurities; thus crystallization is a method of purification.

The water in the crystals of washing soda may be shown by heating some in a tin dish. The crystals will melt and on continued heating, steam will be given off. Not all crystals contain water of crystallization,—for example, common salt, cane sugar.

Boiling Point

It is almost impossible to convince any "domestic" that water boiling furiously is no hotter than when it is just barely boiling. It is instructive to prove this with a thermometer. Also observe that the "simmering" temperature is very nearly the same as the water when boiling, so that cooking may be done nearly as rapidly by simmering and with *far less fuel.*

Latent Heat

This is a somewhat perplexing phenomenon. We all recognize that steam is hot, but that it contains a much greater supply of heat than hot water is not so easy to realize. The following may make this a little clearer: In a small sauce pan or dish put about two tablespoonfuls of water. Heat it to the boiling point and then continue the boiling until it has all boiled away. Note (1) how long it takes to raise the water to the boiling point, and (2) how much time is required to convert it all into steam.

To start the boiling, the water is raised from about 60°F. to 212° F., or through 152°. In converting the water into steam, there is no *rise in temperature*, but the heat has to be applied for a much longer period. On page 12 is the statement that "966 times as much heat is required to change a given quantity of water into steam as to raise it one degree F." but the water in this experiment was raised 150°. As 966 divided by 152 equals 6 (plus), we might expect that it would take six times as long to boil the water away as to

raise it to the boiling point. Of course no exact results can be expected in this experiment, as not all the heat applied is absorbed by the water and used in boiling it, but the experiment will show that the steam must contain a great deal of heat.

A similar experiment will show the latent heat contained in water in reference to ice. If a teaspoonful of ice cold water and an amount of snow or ice which when melted would make a teaspoonful, each be added to a glass of water of the same temperature, it will be found that the pulverized ice or snow lowers the temperature much more than the teaspoonful of ice-cold water. That is to say, a great deal more heat would have to be added to the "ice and water mixture," to bring it back to the original temperature, than to the "ice cold water and water mixture."

Oxygen in the Air

To show that the atmosphere contains a gas which is used up in combustion, attach a candle an inch and a half long to the bottom of a saucer with some of the melted wax. Pour about one-fourth of a glass of water into the dish, light the candle and invert the glass (one with straight sides) over the lighted candle. The flame will grow dim and soon be extinguished and the water will rise about one-fifth way up the glass. This shows a number of things. In burning, the carbon of the hydrocarbons of which the candle is made unites with the oxygen, making the gas carbon dioxide. This takes up the same volume as the oxygen out of which it was formed, but the water quickly dissolves the carbon dioxide and the *pressure of the atmosphere* on the water outside the glass forces it up into the partial vacuum formed.

The nitrogen of the air remains, but this will not "support combustion," and so the candle is extinguished.

Manufacturing Water

That the burning of a candle produces water as well as

carbon dioxide may be shown by placing the flame against a window pane. A film of moisture may be seen, also, when a lamp having a cold chimney is first lighted. The burning of a match will show water when it is placed against a cold surface, but this experiment is not so conclusive, for the wood may contain moisture. The candle contains no moisture, so the water must have been manufactured by the burning.

Atmospheric Pressure

We have had one example of the result of atmospheric pressure in the candle experiment. The working of a siphon is an interesting example. Take a small rubber tube, fill it with water, pinch both ends, put one end in a glass of water, and lower the other end into an empty glass at a foot lower level; release the pressure of the fingers, and the water will run from the tube, apparently going "up hill" over the edge of the glass. The explanation may be found in any text book on physics. This is a good way to empty wash tubs, etc., using a piece of rubber hose.

Carbon Dioxide

Light a splinter of wood and let it burn in a wide-mouthed bottle until it is extinguished. Add a tablespoonful of clear lime water (obtained at any drug store, or add a small lump of lime to warm water in a fruit jar, stir well, cover and let settle over night), close the bottle and shake the lime water around. It will grow milky from the formation of carbonate of lime (calcium), with which we are more familiar in the forms of chalk, marble, and clam shells.

Again with any sort of a tube (a straw), blow into a little clear lime water. It will grow milky, showing that the breath contains carbon dioxide. If you will continue to blow into the lime water for a *long time*, the milkiness will be seen to disappear. This is because the carbonate of lime is dissolved by the excess of carbon dioxide in the water,

after the lime water (hydrate of lime) is all changed into carbonate of lime. This point comes up in connection with hard water and laundry work.

Flash Point of Kerosene

The flash point of a sample of kerosene may be determined approximately by placing about two teaspoonfuls in a cup, then adding hot water to a bowl of water in which the cup containing the oil is placed. Stir the kerosene with a thermometer, and apply a lighted taper to the surface of the oil from time to time as the temperature of the oil rises. A quick flash over the surface of the kerosene will show the flash point. Read the temperature indicated by the thermometer.

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MEETING II

(Study pages 29–55)

If the Food Course is being taken, some of the experiments here suggested might better be postponed until the lessons on *Principles of Cookery* or *Food and Dietetics*.

Starch

The blue color produced by a tincture of iodine (obtained at the drug store) on the faintest trace of starch is a very delicate test for starch. Cooked starch shows the test much better than uncooked. Note that the blue color is destroyed by heat, but appears again when the test is cool. Test various foods — grains, vegetables, fruits, and nuts for starch.

The conversion of starch into dextrin may be shown by heating a little flour or corn starch in a hot oven for half an hour or so, or until it becomes a deep yellow color. Dissolve in a little cold water, filter out the unchanged starch by pouring through absorbent cotton in a funnel; test the filtered liquid to see if there is still any unchanged starch in it. Add double the quantity of alcohol to a part of the liquid. The dextrin will be precipitated, i. e., thrown out of solution and will settle as a fine powder, because dextrin is not soluble in alcohol. The water solution should be concentrated by boiling if much is used.

That the starch is changed by heating with butter or other fat may be shown by adding two teaspoonfuls of flour to one teaspoonful of very hot butter, stirring for some time. Remove a drop on a piece of white paper and test it with tincture of iodine.

Make starch paste by mixing a quarter of a teaspoonful of laundry or corn starch with a spoonful of water and adding it to a cup of boiling water and boil. To about half a glass of this when it has cooled to body temperature (100° F) add a half teaspoonful of saliva. Keep the mixture warm (not

hot) for some time by placing it in warm water. From time to time test small portions with iodine solution as it grows clearer. Add saliva to a portion of hot starch; to a cold portion testing as before.

Gluten

May be the gluten separates from flour as described on page 49, or better as described in "Food and Dietetics" page 41. Bake part of it in an oven.

Experiments with other proteids also described on pages 41 and 43 of "Food and Dietetics."

Experiments with yeast described on page 45 of "Household Bacteriology," Part I.

"Digestion is Synonymous with Solution"

This statement is made on page 35. To show the relation of the length of time required to make a solution, take two equal portions of any crystals, such as washing soda or alum, and pulverize one portion. Stir each in a glass of water and observe the time for each in dissolving. Note that the time required for complete solution is determined by the largest crystal.

This experiment shows how important a part of digestion chewing is and that the teeth are primarily digestive organs.

Cooking Meat

See experiment on pages 50 and 51.

Mineral Matter — Gelatin

See experiments on page 53.

References: Chemistry of Cookery, by Mattieu Williams Pages 19-31. Albumen. ($1.50, postage 16c.)
Chemistry of Daily Life, by Lassar-Conn. Pages 56-66. Digestion of Food. ($1.50, postage 10c.)

(Select and send to the School a composite set of answers to Test Questions on Part I, and report on supplemental work and experiments.)

MEETING III

(Study pages 55–65)

Cleaning: Acids, Alkalies, and Salts

Strips of litmus paper may be obtained at a drug store or will be sent from the School on request. Moisten the blue paper in vinegar, lemon juice, tomato, solution of cream of tartar, etc., and then in ammonia (even the vapor will change it), in solution of washing soda, baking soda, borax, soap, and various washing powders. If the paper is washed in running water after being turned blue with ammonia, a test for acid may usually be found in milk, molasses, and sometimes butter. One piece of paper will be found to turn from blue to red and back again to blue an indefinite number of times when wet with solutions of acids and alkalies alternately.

Buy five cents' worth of hydrochloric acid and a little caustic soda at the druggist's. As caustic soda is unpleasant to handle, it is best to have the druggist dissolve it in water. Now pour a part of the acid into a saucer or glass, with a little water, and add the solution of caustic soda until the mixture begins to turn the litmus faintly blue. In an agate-ware dish, free from worn places, evaporate the solution to dryness. A whitish substance will be found, which by testing will be recognized as common salt.

From two very active chemical substances has been formed a neutral substance — salt. Not all salts, however, are neutral. Sodium carbonate (washing soda) is chemically a salt, but it is made up of a very strong alkali forming element — sodium — and a very weak acid — carbonic acid — and the alkali properties predominate. Cream of tartar is an example of an acid salt. It is acid potassium tartrate, which is a double salt, that is, tartaric acid is added to neutral potassium tartrate, the result being a substance which has acid properties. Common alum is slightly acid to litmus paper.

Soap

Soap chemically considered is a salt, made up of a fat acid and the metallic substance sodium. The fatty acid can be separated by adding any acid like vinegar to a solution of soap. If the solution is warm, it rises as a scum to the top. It can be dissolved in ammonia, forming an ammonia soap. The sodium part of the soap unites with the acid and forms a salt. If hydrochloric acid is added to a soap solution (a sufficient quantity to make the solution very slightly acid), the fatty acid removed, and the residue evaporated to dryness, common salt will be found.

If lime water be added to a solution of soap, white clots of "lime soap" will be formed which are insoluble in water, but on collecting and drying will be found to dissolve in gasoline, naphtha, or kerosene. This is why naphtha or gasoline is useful in cleaning bath tubs, bowls, etc. Quite a good varnish can be made of aluminum soap, made from alum and white soap, dried and dissolved in gasoline.

Washing Powders

It is not difficult to get some idea of the composition of the various washing powders on the market. When acid is added to a solution, if there is effervescence, washing soda is probably present. A skum would indicate that soap formed a part of the mixture.

Hard Water

In the experiment with cabon dioxide it was shown how carbonate of lime might be dissolved by an excess of carbon dioxide gas, the bicarbonate of lime being formed, which is soluble in water. This is an example of an "unstable" chemical compound. Simply boiling drives off the excess of carbon dioxide gas, leaving the ordinary carbonate of lime which is insoluble and is deposited on the sides of the tea kettle or other vessel. This may be shown by blowing into lime water until the cloudiness which at first appears begins

to dissolve. As it is difficult to dissolve it completely, the solution may be filtered. On boiling the clear solution, the milkiness will appear again.

Hardness that is brought about by the sulphate of lime — "permanent hardness" — is difficult to remedy by any household means. Washing soda helps a little, but not very much. The so-called alkali waters of the west, in addition to sulphate of lime contain sulphate of soda and other salts, so that they are beyond remedy.

Reference: Chemistry of Daily Life — The Manufacture of Soda. Page 194.

MEETING IV

(Study pages 66-88)

Laundry Work

Bluing May Yellow Clothes: On page 70 is the statement that the repeated use of ordinary bluing may stain the clothes yellow. To prove this, dip a piece of white muslin into a strong bluing solution — about a teaspoonful of liquid bluing to a cup of water — dry the cloth with a hot iron and boil it in a little strong soap solution. The color will be seen to fade. Rinse and dry with the iron. On comparing the cloth with part of the original piece, a slight yellow stain will be seen. This is oxide of iron (iron rust) and can be proved to be such by adding a drop of pure dilute hydrochloric acid and then a drop of yellow prussiate of potash (potassium ferro-cyanide), the intense blue color produced being a test for iron. The conditions in this experiment are, of course, much more severe than obtained in ordinary washing, as most of the bluing is washed out before the clothes are boiled again, but the experiment proves the possibility. As indigo costs about a dollar a pound and Prussian blue only a few cents, practically all the bluings on the market are Prussian blue.

Iron Rust Stains

Make "rusty water" by letting a few nails stand in a can of water over night or longer. Boil some white cotton cloth in a little of the water. Try the same with wool. Strain some of the water through white muslin and boil the muslin in soapy water.

Stains

One of the classes gave a demonstration before a large audience on the removal of stains as outlined in this lesson. As the only way to learn how to remove stains is to *remove stains*, it would be advisable to make a few, if none are at hand, and then try the experiments on them.

Referenees: Chemistry of Daily Life—Inks. Page 178.
Laundry Work, by Juniata L. Sheppard. (50c., postage 6c.)

(Send answers to Test Questions on Part II, and report on supplemental work.)

MEETING V

(Study pages 89-111)

Baking Powder

Perform experiments suggested on pages 90 and 91.

Reference: Baking Powders. Bulletin No. 119, Maine Agricultural Experiment Station. (Loaned for 2c.)

Lighting

(1) See Experiment page 93.

(2) Insert the small end of a clay pipe stem in the inner part of a candle flame and touch a lighted match to the other and so prove that the candle is a "gas factory."

3) With a piece of wire gauze make the experiments illustrated on page 95.

(4) Visit the local gas plant if there is one — or the electric light station — obtaining permission first from the office.

Electric Batteries

(1) Detach one of the batteries that furnish the current for the electric bell, attach a wire to each pole and place the other ends on the tongue and note that the electric current gives a slight "taste"—i. e., stimulates some of the nerves of taste.

(2) Get some one to explain the action in an electric bell or send 2c. stamp to the School for circular giving descriptive diagram, diagrams for bell wiring, etc.

Plants

Examine with a microscope the "breathing pores" on the under surface of leaves.

MEETING VI

(Study pages 111-122)

Chemical Formulas

Reference: "Chemistry of Cooking and Cleaning," by Richards and Elliott. Pages 9-30. ($1.00, postage 10c.)

"Elementary Chemistry." Text book of American School of Correspondence. (Postage 4c.)

Housekeepers' Laboratory

Make some of the tests described.

Reference: "Some Forms of Food Adulteration and Simple Methods for their Detection." Bulletin No. 100, Bureau of Chemistry, U. S. Department of Agriculture. Send 10c. (coin) to the Supt of Documents, Washington, D. C.

(Send answers to Test Questions on Part III and report on supplemental work.)

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Principles of Cookery

BY

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AMERICAN SCHOOL OF HOME ECONOMICS

CHICAGO

January 1, 1907.

My dear Madam:

Cookery is so old a story to many women that they find little interest in it. Others, though they enjoy cooking and are constantly devising new ways of preparing food and seeking new recipes from their friends, never learn anything of the chemical composition of foods or the reasons for the processes they carry on daily.

Comparatively few have yet studied cookery as they study other subjects, getting at its fundamental principles and grouping its varied formulas in a few general divisions.

In these lessons the attempt has been made to reduce cookery to its lowest terms. It would be impossible to tell the whole story of the art of cookery in so few pages, but by concentrating we are better able to view the subject as a whole. The aim has been to lay a foundation with which each student may become familiar easily and upon which she may build a system of cookery in accord with modern scientific investigation and yet adapted to her own conditions.

For those who have had little or no experience in cooking, the order in which the topics are taken up will be suggestive and helpful--that is, the application of heat to foods, the use of water in cooking, cooking of simple foods as grains, vegetables, and meats, and last, the mixing and cooking of doughs and the making of the more complicated dishes. If possible, all the experiments should be performed, especially when

they are called for in the test questions. Keeping a note book will be found a great help in fixing experiences in mind and in preventing a repetition of mistakes.

Most of our present system of cookery has been derived from the experiments of the generations of housekeepers behind us, but there is no reason why the housekeeper or cook of to-day should cling to the traditions of the past if she can devise a better way. It is hoped that these lessons may induce each student to observe, to adapt, to experiment. New life is put into the simplest routine of daily work if we are constantly watching processes and studying short cuts to better results.

Very sincerely yours,

Anna Barrows.

Instructor

PRINCIPLES OF COOKERY

A NATURAL starting point in the art of cookery is the fire, since cookery without heat is an impossibility. Human beings everywhere use fire to prepare their foods and by such applications of heat man first showed his superiority to the beasts.

FIRE

Among the ancients fire was regarded as a gift from the gods, to be protected in every way, and all civilization, forms of religion, civil ordinances, and family life have been traced to the care primitive man bestowed upon his fire. Among the early tribes, the chieftain was often the only one to have a fire in his home. The hearthstone thus became the center of the home life, the abode of the household gods, and even at the present time it is impossible for some persons to separate the spirit of the home from the kitchen fire.

Ancient Stoves

In different sections of the country may still be seen all the types of fire and stove that have been developed through centuries, and every housekeeper should be familiar with the principles underlying the care of each. Among these are the camp fire where food is broiled over coals or buried in hot ashes, the charcoal brazier of the fruit vender, essentially the same as the portable stoves found in Pompeii, the open fireplace, the brick oven, the Franklin stove, (an in-

vention of Benjamin Franklin), cookstoves adapted to wood, to hard and soft coal, to kerosene, to gas, and the electrical appliances which as yet are little more than toys for the rich.

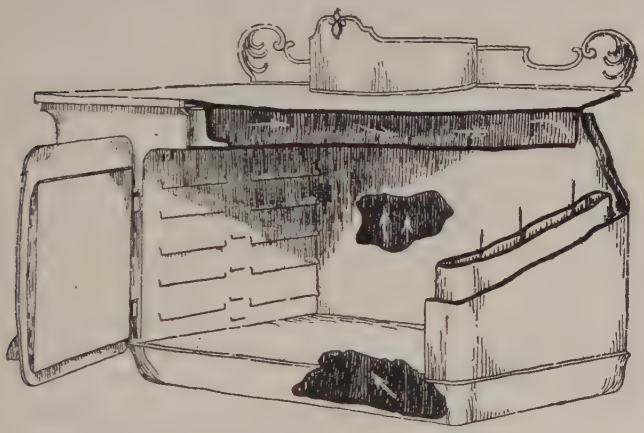
A century and more ago chimneys and fireplaces were often troublesome by smoking and Count Rumford and Benjamin Franklin each in different ways brought their inventive faculties to the solution of this serious problem of daily life. When the fireplace was the dependence of the home for warmth and cooking, the charred, half-burned brands of wood were carefully covered with ashes at night to start the fire the next morning. If the wind had blown off the ashes and the coals were gone out, it was easier to borrow more coals from a neighbor than to use the flint to produce a spark. All this was changed when matches were invented.

A Roman Stove or Brazier.

First Ovens

It was but a step for primitive man from baking in hot ashes or in a covered kettle set on the coals to a simple form of oven. Often one oven served a community. Brick ovens were built at one side of the chimney. Sometimes the heat was turned through a flue to heat these ovens, sometimes a fire was built directly in the oven, and when it was burned down the oven was swept out and the food put in to be cooked

by the heated bricks. The later brick ovens, still used in some old houses, often had space underneath for a separate fire.



An Oven, Showing Direction of the Hot Gases.

Wood as Fuel

For the open fire, wood is the most satisfactory fuel but it is not desirable for continuous use in cooking or heating. Wood is sold by measure, which is an inaccurate method at best. The drier the wood the better it burns, and a hard wood which produces coals is most useful.

When wood is heated and the volatile portions expelled, charcoal is produced. This is usually sold by measure. Its weight is about one-fifth that of the wood from which it is made. It is a primitive form of fuel and generally used in warm countries. A succession of small fires which can be quickly lighted and as

quickly extinguished are more suitable to such conditions than the one large stove or range.

The small stoves used today by the Latin races and their colonies do not differ materially from those of the early Romans.

Charcoal

The charcoal broiler is used by many hotels because of the flavor it appears to develop in meats.

Peat is an important fuel in some sections of the world. It must be thoroughly drained or dried, and at best contains a large percentage of ash.

Both anthracite and bituminous coal have been in common use for less than a hundred years.

Hard Coal

A dense solid, like hard coal, kindles slowly but requires far less care to maintain a fire than wood. Coal is a better fuel for winter than summer. If the lumps of coal are too large they will not kindle readily; if too small, they choke the flame. The large nut and egg grades are best suited to cooking purposes. The draft and size of the fire box determine the size and grade to be used for good results. The free burning "Franklin" coal should be used with poor draft, while with a good draft and large fire box all grades and the larger sizes may be used. A dark brilliant coal will have fewest clinkers. The intense heat resulting from open drafts fuses in large masses the foreign matter which is mixed with the carbon. By burning oyster shells in such cases, new compounds are formed which prevent the clinkers, but the clinkers seldom form with a moderate supply of air.

Soft coal needs very different treatment from hard. Little draft underneath is required, but some draft is necessary over the top to burn the gases given off, and the funnel draft must be open to allow the smoke to escape. If the coal has "coked" over on top it must be broken up when good fire is required. If the fire is to be kept, it is allowed to coke over. **Soft Coal**

Briquettes are made from coal dust and other substances and are used extensively in places where coal is high priced.

The wood and coal stoves and ranges are today the most common means of cooking foods. Housekeepers often become familiar with one stove and one kind of fuel and are unsuccessful with another because they are unwilling to study the laws of nature, or lack the patience to experiment with a new adaptation of them. **Stoves and Ranges**

Much besides personal preference must be considered in the proper valuation of fuels; not only the percentage of carbon, moisture, and volatile matter in each, but the necessary waste, the by-products, and the time required for caring for each and keeping the surroundings clean.

The best stoves and ranges are those plain in finish and simple in construction, with parts well fitted together so that they can be taken apart if necessary and easily cleaned.

A portable range is one that may be moved if necessary, while the "set" range is built into the chimney.

The fire box is lined on the sides with a kind of brick **Fire-Box**

above which the fire should never come. The revolving grate is the most common in recent styles of stoves. There is a grate underneath, and below is a place for ashes or a pan which may be taken out to empty. The oven is surrounded by spaces through which hot gases circulate.

The housekeeper should investigate her stove thoroughly when the fire is out, take off all covers, open doors, remove the "clean out" plate for the space under the oven; then see how the dampers work and explore all passages with a lighted match or candle if need be.

The Draft

The draft given by the chimney depends upon the difference in temperature between the air of the room and the gases of combustion. The hot gases are more expanded and therefore lighter and tend to rise. The hotter the fire the greater the draft will be.

The supply of air is as essential as fuel for a good fire; combustion depends upon both. Smoke and an accumulation of soot are indications of incomplete combustion.

Several drafts and dampers are common to all wood and coal stoves and ranges. They should be open to start the fire, but closed to keep it. The slide under the fire box supplies the fresh air necessary for perfect combustion. A check in the pipe or at the back of the stove under the pipe, or in both places, is usually known as the chimney damper. A slide in the stove pipe or connected with the chimney damper admits cold air into the stove pipe when opened and thus lessens the draft.

Oven Damper

The oven damper turns the heated air away from the pipe so that it goes over the top, down the side, under the bottom, and up the back flue in most stoves and heats the oven before it makes its escape. These differ slightly in different ranges but the purpose of each is the same. Experiment with your own stove until you can control it.

Many ranges have a slide or door above the fire box which may be used for broiling. Hoods are sometimes placed over large ranges to gather odors and excessive heat and convey them to the chimney.

Kindling the Fire

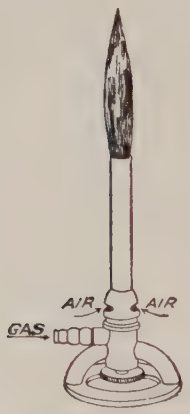
Whether the fuel be coal or wood, the starting of a fire and its care afterwards are much the same process. First remove ashes, brushing off the top of the oven under the covers. When the fire box is clear, put in crumpled paper, bits of wood, and then larger wood and a sprinkle of fine coal. See that all drafts are open. Replace the covers and then blacken the stove, if necessary, but polish after the fire is started. Light the paper and as the wood settles down, add coal, little by little, till it is even with the lining of the fire box. When the blue flame of coal disappears, close the oven damper, and a little later shut the slide under the fire box and the chimney damper. Open the damper when more coal is added. When coal is red it is nearly burned out.

To Keep the Fire

To keep a fire several hours shake out the ashes, fill with coal, close the dampers, and partially open the slide above the fire.

For continual use it is better to add a little fuel at a time, but not in the midst of baking anything. With wood and soft coal the chimney damper cannot be closed as much as with hard coal, because there is more soot and smoke which must be allowed to escape.

Gas is an invisible fuel obtained from several sources. Pure coal gas is more satisfactory than natural gas, or than the so-called "water gas." The escape of the latter is less easily detected and it is much more poisonous, hence there is more danger in using it.



Bunsen Burner.

For institutions at a distance from large towns a private supply of gas which is fairly satisfactory is made from gasoline, and acetylene gas is now often made even for the single house.

Gas Burners

For fuel purposes, the burners are so constructed as to admit sufficient air with the gas for complete combustion. A bluish flame is produced, which is much hotter than the yellow blaze used for light.

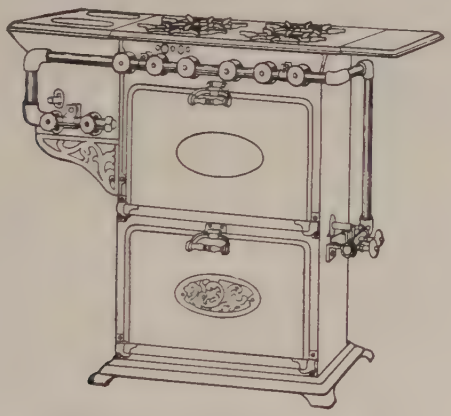
It is possible to admit too much air, which causes a loss of heat. If the air supply is adjustable, close the opening for the air until a yellow flame is produced, and then open it until the flame just comes blue again.

If a burner in a gas stove "burns back" and shows a

yellowish flame, leaving a deposit of soot on the bottom of kettles, turn it out and light it again, being careful that the gas does not ignite back in the pipe before it mixes with the air.

Gas stoves should be connected with the main supply by a pipe large enough to insure sufficient supply of

Gas Stoves



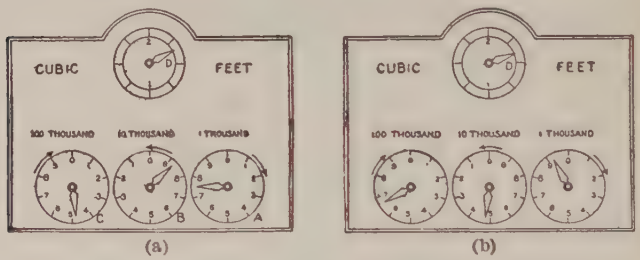
Gas Stove with Oven, Broiler, and Hot Water Heater Attachment.

fuel under all conditions. The amount used can then be regulated by the cook for each burner. Care must be taken to keep the burners and all parts of the stove perfectly clean.

The gas stove is especially adapted to the conditions of the present age; it is far less care than either wood or coal ranges, and at ordinary rates for gas, less expensive when properly operated. Even at high prices

Advantages of Gas Stoves

for gas it is a cheap fuel if human energy and time are considered. The application of a match makes the full power of the stove available at once and as soon as work is done, the flame may be shut off. Any desired degree of heat may be obtained at short notice with no waste of fuel and no debris to be cared for. The stoves occupy small space and each part may be used independently.



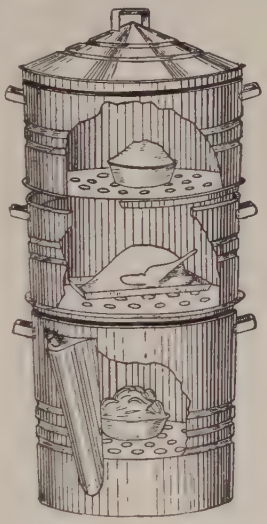
Dial of a Gas Meter, (a) At the Beginning of a Month, (b) After Registering the Amount of Gas Used for the Month.

Gas Meter

The housekeeper should learn to read a gas meter. Each space on the right hand circle passed by the hand indicates the consumption of 100 cubic feet of gas, on the middle circle 1,000 feet, and on the one on the left hand 10,000 feet. Read from left to right, taking the figure just passed by each hand and add two ciphers for the hundreds. A previous reading deducted from the present one shows the amount of gas consumed in a given time.

Example. In the illustration, the hand on dial A has just passed the figure 7, indicating 700 cubic feet; on dial B the hand has passed figure 8 (note that this

hand moves in the opposite direction to the first), and on dial C the hand has last passed the figure 4. The reading is then, 700+8,000+40,000=48,700 cubic feet. If in a month the hands are in the position indicated in the second figure, the reading is 64,900 cubic feet. The difference between the two readings is 64,900—48,700=16,200 cubic feet. Sixteen thousand two hundred cubic feet is the amount consumed for the month.



Steam Cooker, Circular Form.

The small dial at the top of the illustration indicates cubic feet and is used only for testing the system for leakage.

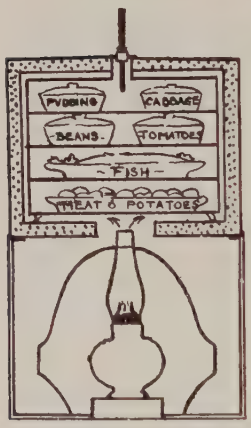
Kerosene and gasoline are useful fuels for summer and emergency use. These are sold by the gallon and only the best qualities should be used. The blue flame kerosene probably are the best of this class of stoves. The small lamp stoves also have merit. They are similar in construction to reading lamps and should receive equal care. Two small stoves often are more useful than one large one, because more readily moved where needed. It is essential that such stoves should stand out of a draft.

Kerosene and Gasoline

Steam Cooker

A steam cooker is an invaluable adjunct to the small stoves whether gas or kerosene is burned. Several articles may thus be cooked over one burner and both time and fuel are saved.

The Aladdin oven is an arrangement for saving heat. It may be used with an ordinary large lamp or with gas. The iron oven is placed inside a jacket of non-conducting substance, hence little heat is lost. It is especially useful for slow cooking.



Aladdin Oven Heated by Lamp.

The Norwegian cooking box is another plan for saving heat. A kettle of food is raised to the boiling point and then packed in a box lined with non-conducting materials.

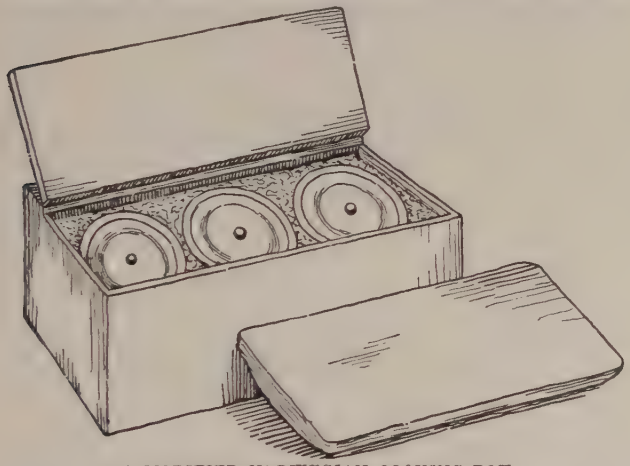
Chafing Dish

The modern chafing dish is but slightly different in effect from the primitive charcoal stove or brazier. The use of alcohol for fuel makes it simple and clean. Wood alcohol—a by-product from distillation of wood—is often used for fuel, but its disagreeable odor makes it less desirable.

Anything that may be cooked over any other stove in a frypan, saucepan, or double boiler may be prepared in the chafing dish.

Effects of Cooking

Heat brings out the flavors in food and develops new ones and makes soluble, substances which the human stomach could not otherwise digest. In most cases moderate heat long continued produces better results than intense heat applied for a short period.



A MODIFIED NORWEGIAN COOKING BOX.

Graniteware Pails with tight covers are packed with asbestos and covered with a pad, the lid of the box is then closed and the whole wrapped in an old blanket.

The degree of heat best adapted to make food digestible is not always that which produces the most acceptable flavor, hence cooking must be more or less of a compromise. As yet we know little about the degree of heat best suited to the perfect cooking of each food and the temperature at which it should be served.

Nothing will cook until it is warmed, and warming and drying are usually the first steps in the cooking process.

Transmission of Heat

The transmission of heat from a fire to our foods may be by conduction, as when heat travels along a bar of metal, by convection, when heat is transferred by the motion of heated liquid or gas, and by radiation through the air. The effect of heat on the food is further modified by the way the metal or other substance containing the food is affected by heat.

The use of asbestos in the form of mats and linings for ovens and jackets for kettles to modify the heat transferred to food is likely to increase in the future.

Boiling

Broiling probably was the first attempt at cooking since it required little beside the fire and the heat. Roasting is a similar process applied to larger sections of meat and therefore requiring a longer time. The relationship of roasting and broiling is most apparent with a gas range for there is no line of separation between the cooking of thick steaks and thin roasts. Much so-called roasting is really baking.

Roasting

In broiling and roasting, tender portions of fish, flesh or fowls are exposed to intense heat at first to sear the outside and close the open tubes or pores which contain the juices. The fire should be free from smoke and may be charcoal or half-burned wood or coal or gas. After the surface is browned the section of meat should be drawn away from the intense heat and kept at a more moderate temperature until cooked thoroughly. More depends upon the shape of the article to be broiled or roasted than upon the weight.

When a thick mass is to be cooked in this fashion it

becomes necessary to modify the heat on the outside and to aid in driving it in by the process known as basting; that is, dipping up the hot fat which has dripped into a pan beneath the meat and hence is known as dripping, and pouring it over the outside of the mass. The glossy brown secured by basting may have suggested to some early cook the advantage of deep frying. **Basting**

Chafing-Dish—the Modern Brazier.

The difference between broiling over coals and in a hot pan is but slight and dry frying or sautering is a similar process. Toasting is a similar application of heat to foods already cooked once.

The earliest forms of baking were in the hot dishes and then in covered kettles set in coals or hung over the fire. Our ovens are an outgrowth from those primitive methods, and now much so-called roasting is really baking.

A point to study in this connection is the fact that food is fuel for the human body. The amount and

quality of fuel is varied according to the work to be done, so should the food be chosen according to the work of the individual and the climate or season of the year.

WATER

Water is not always considered to be strictly a food in itself, but by its aid many foods and flavors are put in forms more acceptable to the palate and more readily absorbed by the body than they could be in any other way.

Importance of Water in Cooking

Immense quantities of water are necessary for the preparation of food and the cleansing of dishes in addition to what is needed for laundry and bathing purposes. Cities make provision from some source safe from contamination for the water needed by their inhabitants. In small communities the individual family must each be responsible for its water supply. This is not the place to discuss the medical aspect of the water question, but all agree that water should be above the suspicion of danger of transmitting disease. Moreover, for household purposes water should be clean and soft, since hard water containing mineral salts hinders processes of cooking and cleaning.

A limited water supply or inconvenient arrangements for its use and disposal afterward, tend to reduce the consumption to such an extent as to interfere with the proper cooking and service of food, if not below the actual standards for health.

Nearly three-fourths of the human body is water and a similar proportion will hold in most foods served at our tables. The total amount of water taken by a human being daily averages two or three quarts, or from four to six pounds. The portion of this which is taken as a beverage depends upon the solidity of the food.

Mineral Water

The benefit gained from mineral waters often is quite as much due to an increased consumption of water as to the mineral constituents they contain. The tendency of civilized man in feeding himself is toward too concentrated foods, too little water as a beverage and too little watery food. Water not only brings solids into the stomach in an acceptable form, but it is essential in building new tissues and removing wastes. The inside of the body, as well as the outside, sometimes requires washing.

The temperature at which water is taken into the stomach is an important point. A glass of cool water sipped slowly may have as stimulating an effect as one of wine. Often more ice than water is found in the glasses on American tables, and the ice water is taken hurriedly and interferes with digestion.

Hot water taken slowly will often revive tired people as effectually as tea or coffee. The merit of soup as a first course at dinner probably is due to the fact that it contains ninety to ninety-five per cent hot water and that the solids are largely in solution and absorbable.

If clear hot water is an unpalatable beverage, salt or lemon juice may be added to give a distinct flavor.

Flavor of Water

There is a marked difference in flavor between water freshly boiled and that which has been kept hot for a long time. The latter has lost the gases which give life to fresh water. For any purpose in cooking stale water will injure the flavor of foods whether it be taken from a hot water faucet or from a teakettle where it has stood for hours.

Other ill flavors come into our foods because of imperfect utensils, badly washed. A rough surface or seam will retain something from previous cooking to add to the next substance cooked therein, or greasy dishwater or soap may be left in sufficient quantity to give an appreciable change of flavor.

Another important use of water essential in good cooking is for the cleaning of utensils.

Dishwashing

Dishwashing is not a popular occupation probably because repairing or setting to rights is never quite as interesting as the construction of something definite. Insufficient appliances and inconvenient conditions for the work are other causes for its unpopularity.

With a convenient sink of the right height, ample table room for soiled and clean dishes, abundance of towels and hot water, dishwashing loses its terrors.

A knowledge of the composition of each food and the way it is affected by different degrees of heat is as desirable in dishwashing as in cooking. For example, where gelatine has dried on a strainer it should be

softened in cold water, but that treatment would not be helpful if the strainer had been used for fry fat, while an egg beater plunged in boiling water would be all the harder to wash because the egg would be cooked. Time is saved by careful sorting and scraping of dishes before washing. Detergents are helpful but less important than abundance of water.

Soaking Dishes

Strong soda water boiled in a utensil will remove food that has burned on. Soaking is as helpful in dishwashing as in the laundry and dishes that cannot be washed as soon as used should be covered with water. After washing, any dishes are improved by rinsing in scalding water.

The usual plan is to wash dishes in this order, glass, silver, crockery, cooking pans, or kettles. Often it is more desirable to get the large pieces out of the way first.

It is half a century since the first dishwashing machine was invented and though they are in general use for hotels, hand work seems better adapted to most households.

To illustrate the effect of the range of temperature from the block of ice at 32° F to the steaming kettle at 212° F let us follow the process of making a simple gelatine jelly. The gelatine has been extracted for us in factories from bones of animals and needs no cooking, but must be dissolved and combined with liquid and flavoring. It is first softened in cold water, the time required varying according to the size of the parti-

cles of gelatine. Then it must be dissolved with boiling liquid. Use only as much boiling liquid as is necessary to dissolve the gelatine. The sugar, if that is to be used, added next, because it will dissolve more rapidly in a warm medium, and then is put in the fruit juice or whatever is to flavor the jelly.

Gelatine Jelly

The compound is to be strained and cooled. The larger the mass the slower the cooling.

Experiment. To illustrate this put half the jelly in one mould and the other half in several cups. The cup will be firm before the large mould at any temperature.

To illustrate another point put one cup in a pan of snow or cracked ice mixed with coarse salt. When some of the jelly is half thickened combine with it whipped cream or white of egg.

If possible take temperature of each with a thermometer. The key to all gelatine desserts, is to have proper proportions of gelatine and liquid and to have the right temperature for the different stages. The proportions are given by each manufacturer on the package.

METHODS OF COOKING IN WATER.

Water is as essential as fire in all processes of cookery. No food can be cooked without water and unless it naturally contains a large proportion of the fluid, more must be added during the cooking process.

Boiling

Cooking food *in* water indicates further progress in

this art than either broiling or roasting. It implies the invention of a kettle to contain the water, though the earliest cooking of this sort may have been done by dropping heated stones into a hollow one containing the water and meat or into a water tight basket. Homer and other ancient writers have nothing to say about boiled meats, though they mention those which were broiled or roasted.

Boiling, stewing, and steaming are slight variations of the same process. Under ordinary conditions, without pressure, no food thus cooked can be raised to a higher temperature than 212° F at sea level, and at high altitudes few foods can be cooked in this way, since water boils at a lower temperature.

Experiment. Much may be learned by heating a given measure of water and watching it until it reaches the boiling point.

Tiny bubbles hardly larger than the point of a pin soon form and rise to the top, but this is not boiling. The same thing may happen in a glass of water standing for an hour on the table. How will you explain this?

When the water is actually boiling large bubbles rise rapidly and break on the surface. Keep up this process until nothing appears to be left in the pan. Where has the water gone? Has anything been left behind? There will usually be a trace of coloring matter to indicate that solids do not evaporate.

This point may be made more apparent by putting a

tablespoonful of salt in the water that is to be evaporated.

What is left behind in a teakettle which is never cleaned inside though the water is allowed to boil day after day?

Evaporation

Experiment. Other simple experiments may be made with two dishes of uniform size containing the same amount of water exposed to the same heat, one covered, the other uncovered. Which reaches the boiling point first? From which does the water first evaporate?

The evaporation of water is an important factor in cooking. The rate of evaporation is proportionate to the surface exposed to the air and not to the amount of water in the kettle.

Thus the same quantity of syrup or sauce made in a shallow pan will naturally become thicker than when cooked for the same time in a deep pan having only one-fourth the surface.

Choice of Utensils

The art of the cook is displayed by the proper choice of utensils, or, if utensils are limited, by varying the time of the process or by the addition of more water for different purposes. Where long cooking is necessary choose deep utensils, reserving the shallow ones for the occasions when haste is essential.

The use of a cover serves several purposes; it protects the food in the kettle from foreign matter from outside, it aids in retaining the heat, and prevents the loss of water to some extent, as much of the steam condenses and runs back.

Even without a thermometer it is evident that water cannot be made as hot as fat, for a potato, a bit of meat, or a lump of dough might be cooked in water indefinitely without assuming the brown color which would come to any one of these articles in hot fat.

By observation also, we might discover that, however rapidly the water in a kettle boils, potatoes or other foods do not cook more quickly. In the same way we should find that absolute boiling or bubbling of the water was not necessary in order to cook some foods.

Temperature in Cooking

Through such observation and experience certain common laws of cooking have been established and these have been verified and explained by the experiments of modern scientists. The temperature of the water should be adapted to the type of food material to be cooked in it. Vegetables containing woody fibre to be softened require the boiling-point, while meats and eggs, of different composition, will cook more perfectly at a lower temperature. To extract juices and flavors of meats and vegetables to the fullest degree divide the substance finely to expose as much surface as possible to the action of the water and let that be cold. Soak first, then heat the whole slowly and hold below the boiling point till the end is gained.

Cooking with Water

When water is used only for the purpose of conveying heat let it be boiling hot when the food is put into it. Even then some of the solids in the food will be dissolved in the water and lost unless it be used. In some cases, as in strong flavored vegetables, this may be a

desirable loss. Mediums like hot fat, a thick syrup, or a gravy in which water is thickened with flour, by their density prevent loss of shape and flavor in the articles cooked in them. Rapid boiling in water tends to disintegrate foods. Meats are cooked to rags, potatoes become a soggy paste, and no intensity of heat is gained.

A Double-Boiler—an Invention of Count Rumford.

Stewing

Stewing implies moist heat, a sort of sweating process. Boiling requires much water, at its highest temperature; stewing is done with little water at a heat sufficient to soften the substance, but considerably below the boiling point. Hence boiling is more applicable to vegetables and stewing to animal foods.

Braising

Braising and fricasseeing and pot roasting are combinations of broiling or frying and stewing. Sections of meat are first browned to secure a good flavor and then stewed until tender in broth or gravy.

Water is a restless substance and is constantly escaping from the surface of our foods while they are being cooked. Keep the water in the right place, is a watchword against many of the difficulties that arise in cookery.

When a sauce or soup is too thick water may be added. On the other hand, when such foods are too watery the surplus often may be evaporated by cooking rapidly, uncovered, for a short time.

The Double Boiler

Besides kettles of various shapes, the double boiler and the steam cooker are important utensils dependent for use upon water. The double boiler we owe to the inventive genius of Count Rumford. Here is one kettle set in another containing water, and so long as there is water between a food and the fire no browning can take place in the food. This utensil is especially associated with compounds of milk and with the cooking of cereals. Though the food in the upper part does not quite reach the boiling point, this disadvantage is more than balanced by the long time which may be allowed for cooking with no danger of burning.

The steam cooker is found in many patterns, all on the same general plan. It differs from the double boiler in having several parts above the kettle containing the water, each with perforated bottom, so that the steam and vapor have direct access to the food.

The "bain marie" is a French device to serve the same end. One large kettle of water contains a number of

deep sauce pans. This is especially useful for food already cooked which is to be kept hot for intermittent serving in restaurants.

Coffee Pot for Making Drip Coffee.

The prevalent idea that all food must be served the moment it is cooked is due in many cases to imperfect methods for keeping it warm.

For tea and coffee a moderately soft water is generally considered best.

The different kinds of tea receive their name from the locality where they grow and from the size of the leaf, the younger leaves furnishing the choicer varieties. (See the illustration and description given on page 139 of *Food and Dietetics*.)

Making Tea

To make tea, use an earthen pot, fresh boiling water, and from one-half to one teaspoonful of tea for each half pint of water. Leave covered in a warm place to steep for three to five minutes and serve. For cold tea drain from the grounds at once.

Coffee

Names mean little in brands of coffee further than to indicate the original home of a special variety of the plant. The berry improves in quality for several years but loses flavor after roasting and more after grinding. One pound of good coffee measures about one quart and will make at least thirty full cups of strong coffee. Thus one pound should supply one person for a month

or four persons for a week. It is better to buy coffee in small lots often, unless it is ground as used.

Coffee may be steeped like tea or boiled. All things

STEAM COOKER WITH DOORS.

considered, the drip coffee pots are most satisfactory and the beverage thus made is more economical and uniform and probably less injurious than when it is boiled.

ICE

Ice is becoming more and more essential to civilized man, not only for summer use but for the year around. The future promises many improvements along this line, in more rigid inspection of the sources of the natural ice supply, in improved facilities for the manufacture of artificial ice, perhaps even in the individual home, by the transmission of cold brine as gas and water are now supplied from house to house from central plants, making it possible to dispense with the iceman's daily round. Patents have been issued for methods of cooling houses in summer similar to those used in cold storage plants. Food is now sent long distances in refrigerator cars and the whole subject of refrigeration has received much study. It has been found that different foods require various degrees of temperature.

Cold Storage

The preservation of food by cold storage is of great benefit to armies and navies, but is not an unmixed blessing to the housekeeper for it has upset the seasons of foods, and when we can obtain a food at any time of the year it loses the charm it possessed when the season was a short one. Moreover, though food in cold storage does not spoil, it parts with something and undergoes certain changes which are not fully explained as yet. The housekeeper is usually safer in the use of canned foods than of those subjected to a long period of cold storage.

The household refrigerator is frequently expected to do impossibilities in caring for foods. It is a great labor saver when properly used and may be depended upon the year around and not merely in summer.

The Refrigerator

It should be placed in a cool, light, airy place, convenient to kitchen and dining room unless a second

A Refrigerator showing Direction of Air Currents.

refrigerator be placed there. If possible place it near the door so that the ice man need not track all over the kitchen floor. The cellar is no place for a refrigerator. A good cellar is a safe place for most foods, and a poor one will injure the refrigerator.

In many households the cost of ice is more than saved by the preservation of food that would otherwise be lost. The average family will use from one to two dollars' worth of ice a month at city prices.

In modern houses the water pipe from the ice com-

partment of the refrigerator is often connected with the sewer pipe. This should never be direct. Let the pipe drip into a spout.

A refrigerator should have several compartments, that foods like milk and butter may be kept apart from others. The coolest place is usually under the ice. A tile or enamel lined refrigerator has many advantages, but any that are properly made if kept clean will do good work. Any break should be repaired at once, for an overflow of water or a crack in the lining may cause an odor which will flavor all food.

Care of Refrigerator

The ice should be washed clean before putting in place and no food should ever be placed upon it. The jars of water chilling for table use are the only things to be allowed beside the ice in its compartment. No food should be put away while warm.

How often a refrigerator should be cleaned depends upon the way it is used. If nothing is allowed to spill or rub against the sides or shelves, or, when this happens, if it is cleaned away at once, and if nothing stays there until unfit for food, frequent scalding is unnecessary. Every week or fortnight when the ice is nearly out remove shelves and scald them thoroughly and wash throughout.

Glass and stone jars, deep earthen and agate plates are the best utensils in which to put foods away in the refrigerator.

The principle of the refrigerator is exactly that of

the Aladdin oven—a closet with shelves is put inside a case of non-conducting substance.

On the same plan, our ice cream freezers are built. The outer tub is a non-conducting substance to prevent the entrance of heat. Ice Cream Freezer

There are jugs for hot water and coolers for ice water constructed according to the same idea.

Salt is mixed with ice because its affinity for water will cause the ice to melt, and when a solid changes to liquid form, heat is absorbed from the surrounding objects. Cracked ice about the size of coarse rock salt is used, the proportion being three parts ice to one of salt.

Ice cream, custard, or fruit juice to be frozen, should be more highly flavored and sweetened than if it were to be eaten at an ordinary temperature. The organs of taste are benumbed by the cold, and a stronger flavor is necessary to produce an effect. The cost of ice for making frozen desserts is less than the cost of fuel for cooking many.

All processes of cooking are the result of gradual evolution. Nature ripens fruits and seeds in the sunlight. Dry nuts and seeds are stored by squirrels and other creatures. Primitive men were but little in advance of the squirrel when they saved different grains and pounded or parched them for food.

Uncooked Food

We may understand better the origin of our processes of cooking if we first consider the foods available without special preparation. Tropical countries have always afforded a variety of fruits capable of sustaining human life. It is estimated that many more persons may be supported on a given piece of ground planted to bananas than by the same surface planted with any crop in a temperate climate. The breadfruit, fig, date, and raisin are other important fruit foods.

In temperate climates without knowledge of agriculture mankind must depend largely upon animal foods, and doubtless here would come the first application of heat to change the flavor or to aid in preservation of the food from day to day.

Preserving Food

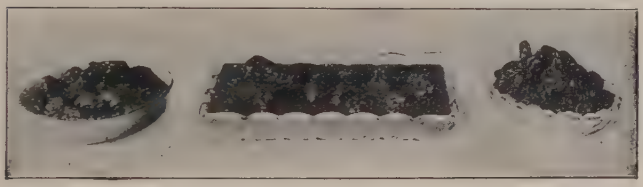
The drying of fruits and the smoking of meats naturally were the earliest methods of preserving foods. Probably the preservative action of smoke was accidentally discovered and the salting of fish may have been derived naturally from its association with salt water.

Since all foods are mainly water it was an immense advantage to wandering tribes to reduce their burdens

by drying their foods. Even the most primitive housekeepers discovered that in proportion as food parted with water it was less liable to ferment, mould, or decay, though the scientific reason for this that most bacteria can live and develop more rapidly in fluids has only been discovered recently by bacteriologists.

Dried Foods

The modern housekeeper seems to be losing the art of drying foods, yet in many cases that mode of preservation is more desirable than canning or cold storage.



Dried Prunes Before and After Soaking.

One reason why dried fruits have fallen into disrepute is this: To remove the discoloration which takes place when cut fruits are dried or evaporated in factories they are often bleached by sulphur and suffer loss of flavor. Another reason for not using dried foods is that it takes time to soak them.

When they are to be made ready for use the first step is to supply as much water as they lost from evaporation. This is best accomplished by long soaking without heat, merely cooking them enough at the end to soften tough fibres and to prevent fermentation.

Honey and olive oil may be considered with the food products requiring little preparation. They were commonly used by the ancients.

Nuts

Nuts are an important food in some parts of the world. The peasantry of southern Europe find in the chestnut a substitute for cereals. It is made more digestible by a partial cooking. The neglect of nuts in our country is due to the cheapness of cereal products but there is an increasing use of them as a substitute for meats. Average shelled nuts have weight for weight about twice the fuel value of wheat flour because they contain so much fat. Chestnuts are about two-thirds starch, and contain little fat. Other nuts are from one-third to two-thirds fat.

It is a common idea that nuts are very indigestible. That may be changed if we learn to masticate them properly or to grind them and combine with other foods instead of eating them without chewing properly, as dessert after sufficient nourishment has been taken.

Nuts and fruits supplement each other, to some extent, the one containing what the other lacks.

The leguminous seeds, peas, beans, lentils, and peanuts, are somewhat like nuts, but are not so rich in fat and are unpalatable unless cooked. Most of our common vegetables are the result of ages of cultivation.

Fruits

We are only on the threshold of the possibilities of combining and preserving fruits. An increased use of fruit, fresh and preserved, will tend to cause a diminished use of alcoholic beverages. Fruit juice is one

of the best agents to quench thirst. A desire for some other beverage than water may be taken as a cry for food. Fruit juices, hot or cold, will better supply this desire than tea or coffee. The expressed juice of real fruit may be sterilized and then charged with carbon dioxide, as well as the chemical compounds now sold as soft drinks.

Jellies

Inferior fruits and skins and cores, if clean, may under pressure yield juice for jellies, or to flavor other foods. Fruits may be blended, pressed, and strained, and used in many ways even for children and invalids when the solid particles and seeds would prove irritating. The juice of the lemon or orange and the pulp of the banana may thus be combined.

Canned Goods

Since modern housekeepers lack patience to dry foods and soak them out again the canning factory has come to their aid. Within the last half century this business has developed immensely. Home canning cannot compete with that of the factory, because there a higher temperature is gained which more effectively sterilizes the food.

Canned foods keep because the bacteria in them are destroyed and others cannot enter because the air is kept out. Fruit will not spoil even if the jar is not full, provided the air above it has been sterilized.

Unfortunately, ignorance of the processes involved makes the consumer demand impossibilities in color and form, and this has led the manufacturer to use artificial colorings freely.

Preservatives of different kinds have been found to be cheaper than care and time expended in the preparation. Clean foods keep better than unclean ones, but skilled human labor is the means to cleanliness and that is expensive.

Preserving in Sugar

Pound for pound preserves which include jellies made from fruit juice and marmalades from fruit pulp with equal weight of sugar keep even if exposed to air, because bacteria do not flourish in dense substances.

Some fruits are preserved half by drying in the sunshine, half by sugar. Spiced fruits were more common before the days of air-tight jars, for spices are enemies of bacteria.

Canning

The canning of food is not a complicated process. Everything must be clean, that is, free from spores of mould or germs that promote decay. Such cleanliness may be accomplished in part by water, partly by heat. The jars, covers, tunnels, and spoons must be subjected to boiling water to render them sterile. They are usually put in cold water which is slowly brought to the boiling point. The scalding of tomatoes and peaches not only renders the skin easy of removal but sterilizes the outside so that nothing is rubbed on to the inner surface as it is peeled.

An accumulation of dust, mould, and decayed portions, even if each be slight, cannot but affect the result. Therefore the fruit for any purpose must be carefully picked over and washed. Very juicy fruits, like currants, may have the juice expressed without first

cooking, while others, like the crab apple, require the effect of heat to start the juice.

Utensils for Canning

The utensils for cooking and straining should not be of metal if the best flavors of the fruit are to be retained. Agate or earthen ware kettles, wooden spoons, and linen strainers are desirable for this work. If

"LIGHTNING."

IMPROVED "MASON."

PRESERVE JARS.

necessary to use metal anywhere, do it as quickly as possible, and never leave an iron spoon in a kettle of cooked fruit.

Sugar is not essential to canning, but is usually added for flavor and because fruit cooked in a syrup keeps its shape better than when cooked in water.

Preserve Jars

The best jars are those having glass covers and fastening with a spring. The screw tops are easily rendered imperfect and are hard to close and open.

The less lettering there is in the glass the surer we are of keeping it clean. The rubber rings spoil quickly and none that are stretched or brittle should be used. New ones are usually required every year. Pint jars are more satisfactory for the average family than the larger sizes.

A grocer's tunnel is desirable for filling the jars, and a half-pint dipper with a long handle is another help.

Essential Points

The essential points in canning fruit may be summed up in very few words. All that is necessary is to have the fruit and everything that comes in contact with it sterilized, and then keep the air away from it. That is, the fruit and whatever it touches must be raised to a sufficient degree of heat to destroy any micro-organisms already there that would cause change of form or decay. This being done care must be taken that no others are allowed to enter through the air. There is no magic about it, only constant watchfulness.

Gentle cooking, long continued, seems to be fatal to the bacteria, which might work so much ill, and this method is more conducive to preserving the natural appearance of the fruit than is intense heat for a short period.

Fruit, vegetables, milk, and meats all are prepared in similar fashion. Animal foods spoil easily because of their composition.

CHOICE OF FOOD

Primitive man made use of anything near his hand to satisfy his need and accidents and extreme hunger made many foods appetizing to our ancestors which might not appeal to us today if we had not inherited the taste for them.

According to W. Mattieu Williams, "the fact that we use the digestive and nutrient apparatus of sheep, oxen, etc., for the preparation of our food is merely a transitory barbarism." Other authorities agree with him that the art of cooking may some time be so developed as to enable us to prepare the coarser vegetable substances in an easily assimilated form without depending upon animals as middle men.

The Art of Cooking

The art of the cook has done much to make unlikely food materials attractive, but there is another phase of the question, and that is the problem how to make what we know is nourishing both pleasant and attractive. The cook of the past had to make the best possible use of the meager nutrients at hand. The cook of the present and future has the harvests of the whole world within reach all the year around. How shall such abundant material be combined to satisfy the palate without overloading the digestive organs?

More important still, how shall we select and prepare foods that they may produce sufficient energy in the human body for the great tasks awaiting it in our complex civilization.

During the last twenty years or less much material has been published by the U. S. Department of Agriculture recording the results of investigations. Many of these pamphlets can be secured for the asking.

Classification of Food

For practical use all the principal substances found in our foods may be classified under five heads: water, mineral matter, protein, fat, and carbohydrate. The first, and its importance in cooking, has already been considered. The second appears in different forms in all foods, rarely exceeding one per cent. of their natural weight. This it is which remains as ash when a food is burned. It is most prominent in the refuse portions of food which are removed before coming to the table, such as the husks and bones. Some of these mineral matters are readily soluble in water, hence are lost when no use is made of the water in which vegetables are boiled.

Common salt is the principal mineral substance in use in cooking.

Organic Foods

The other three great classes of food substances are known as organic compounds,—the protein, fat, and carbohydrate.

The proteins are subdivided into many classes, but so far as practical cooking is concerned, little need be said of these here. Since this type of material constitutes about one-fifth of the human body by weight it must be found in the daily food. Lean meat, eggs, milk

*Following the nomenclature of the U. S. Department of Agriculture, the term protein is used to denote all classes of nitrogenous foods.

curd, and portions of grains and seeds are the principal sources of this class of food. As a whole, protein of vegetable origin is more slowly and less perfectly absorbed than animal protein. The principal duty of nitrogenous foods is to build up the body and to keep it in repair.

Fats

Fats are obtained from both animal and vegetable sources and for the convenience of the cook are commonly separated by heat or pressure. Considerable fat is stored as a reserve fund in the normal human body. Its principal office is that of fuel to keep the body's machinery going.

Carbohydrates

Carbohydrates are chiefly of vegetable origin and include starch and sugar. They are not apparent to any extent in the body but are important fuel foods, though more than two pounds of starch or sugar would be required to produce as much energy or bodily heat as one pound of fat.

The provider of food, the cook, and the consumer all should be familiar with the composition of common foods in order that the daily meals may be adapted not only to purse and palate but to climate and the condition of individual bodies.

MILK AND ITS PRODUCTS

Milk is a complete food for the young animal because it contains the five fundamental types of food material—water, mineral matter, fat, carbohydrate, and protein.

The analysis of average milk is about as follows:

	Per cent.
Water	.87
Mineral	.01
Fat	.04
Casein	.03
Sugar	.05
	1.00

Since the fat is the most valuable portion commercially, dairymen study to feed their cows in such a way as to increase it, and in some instances milk has been produced containing 6 per cent of fat.

Use of Milk

Though mainly water, milk is a valuable nutritious food and should be used freely by itself and in combination with other food materials, in soups, sauces, and puddings. When we remember what the department of agriculture has proved for us, that a quart of milk is quite as nourishing as a quart of oysters for which we pay six or eight times as much, we can see that it is desirable to use it more freely than is generally done. Especially during the summer months we do well to substitute milk and cheese for meats. There are average families which do not use over a pint of milk a day; there are others who find it neces-

sary to take a gallon, and the meat bill in the latter cases becomes proportionately small. A pint of milk a day is not an excessive allowance for each member of a family, though many households consume much less.

Composition of Milk

To study the composition of milk put a quart of fresh milk in a glass jar and leave it twenty-four hours or longer until it is thick and sour. What percentage of the whole is the cream? Remove the layer of cream on top to another jar, screw on the top, and shake until the fat separates from the watery portion of the milk. Collect the butter on a spoon, wash out the milk by pressing and folding with a knife. Weigh or estimate carefully the value of the butter obtained. What proportion of the original bulk of milk does it represent? Persons fond of unsalted butter may thus prepare it for themselves.

Why is salt added to butter?

The remainder of the milk, now a thick mass of curd, may be pressed out with a spoon or cut with a knife to show the greenish water known as whey. What nutritive substances are there in this?

Turn the thick milk into a two-quart pan and fill with hot water, in twenty minutes drain the water off through a strainer, that no curd need be lost, and pour on more hot water. Do this several times until the curd loses its sour taste and has contracted, but do not allow it to become too hard. If boiling water is used the curd will become unpalatable and indigestible.

Buttons have been made of sour milk treated by heat and pressure.

Sour Milk Cheese

Press as much water as possible from the curd and compare the quantity with the original amount of milk. Remember that this still contains much water. Now combine the curd with butter or thick cream, salt it and shape in small balls or pack in cups. Thus we learn something of the value of milk and have made a sour milk cheese more palatable than when the whole mass of curdled milk is heated on the stove or strained in a cloth.

Junket

With prepared rennet in liquid or tablet form the curd and whey of sweet milk may be separated. The milk should be warmed slightly before the dissolved rennet is added, then chilled in the dishes from which it is to be served. This is known as junket or rennet custard.

Absolute cleanliness is essential for every utensil to come in contact with milk. The souring of the milk is due to the action of bacteria which come to it from contact with utensils and the air. Its fluid form and nutritive material afford a medium peculiarly favorable to the development of germs of disease, as well as to the growth of useful bacteria which aid in butter and cheese making.

The growth of such micro-organisms is hastened by moderate heat, but most of them are killed by raising the milk to the boiling point.

Sterilization requires a temperature of two hun-

dred and twelve degrees F, continued for about twenty minutes; this process usually changes the flavor of the milk so that it is disagreeable to many palates. The high temperature also causes the fat globules to separate instead of being retained in the form of cream.

To Prevent Souring

Pasteurization takes its name from the noted French scientist, and consists in raising the milk to a temperature of about one hundred and fifty-five degrees F. By this means the flavor of the milk is unchanged.

The cook finds it safe to scald the milk for soups, bread, or puddings, to prevent its souring during the process, before cooking it with the other ingredients. There is a gain in the time of cooking when the milk is heated while the other materials are being prepared.

Neutralizing Acidity

A bit of bicarbonate of soda dissolved in milk before it is heated often will neutralize any incipient acidity and make it usable for puddings or soups. The "cream" of tomato soup is liable to curdle unless the acid of the tomato is neutralized by soda or the milk thickened with flour before the two parts are combined. It is safer with all "cream" soups to keep the stock and thickened milk apart until just before using.

Mixing with Acid

Lemon or other acid fruit juices are sometimes mixed with milk for sherbet without curdling if, before the juice is added, the milk is thoroughly chilled in the freezer can.

Salt sometimes curdles milk, especially when it is added to hot milk.

Since the solid portions of milk readily adhere to the bottom of the saucepan placed in direct contact with heat, and the resulting burned flavor rapidly penetrates the whole of the milk, a double boiler or its equivalent, one dish set in another of boiling water, is the best way to heat milk.

Milk is an important ingredient in preparing cocoa and chocolate, and such beverages rank with soup in nutritive value. Hot milk sipped slowly is a simple remedy for exhaustion and sleeplessness. Hot milk should be served with coffee when cream is not available. The milk soups are valuable foods and have as their foundation the white sauce described further on.

Most of our puddings require milk, especially the cereal and custard varieties.

Cooking in Milk

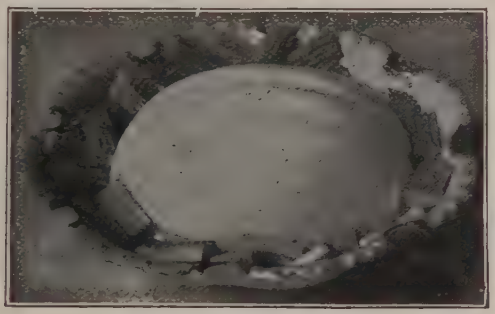
Because there are solids in the milk more time must be allowed for the grains of rice or corn meal to absorb the moisture than when cooked in water. The protein portions of the milk have somewhat the same effect as the egg used to coat the croquette or oyster before frying. If the particles of grain are thus varnished over they cannot absorb moisture as rapidly as from clear water. Hence, it is often advisable to cook the grains in water first and finish the process in the milk.

In making blanc mange from Irish moss, if the moss is first cooked in a small quantity of water and

the thick paste strained before it is added to the milk, there is no loss of milk. When the moss is cooked directly in the milk there is some loss of milk when the moss is strained out.

Concentrated Milk

The baked Indian meal pudding and the creamy rice pudding require long, gentle baking. There is a continual evaporation of moisture from the surface of



"BLANC-MANGE."

the pudding pan, and really a condensing of the milk. In proportion as the pudding dish is refilled with milk, the pudding increases in nutritive value.

Milk is commonly used for mixing dough of many types and this adds to the nutritive value of bread and cakes.

Bread made of milk or part milk will have a browner, tenderer crust than bread made wholly with water. There seems to be good ground, however, for the prevalent idea that bread or cake made with milk does

not keep so well as that made with water. A certain cheesy flavor develops where milk is a principal ingredient.

Sour Milk

Sour milk is often used for mixing griddle cakes and quick doughs, because the acid it contains will be neutralized by the soda added, and thus produce the effervescence which makes the dough light. The souring process seems to have so affected the protein substances in the milk that such a dough is tenderer than one made with sweet milk and baking powder. The use of sour milk will be further treated in the section on doughs.

Skimmed Milk

For doughs, soups, and puddings, in which additional fat is introduced, skimmed milk may be used as well as full milk.

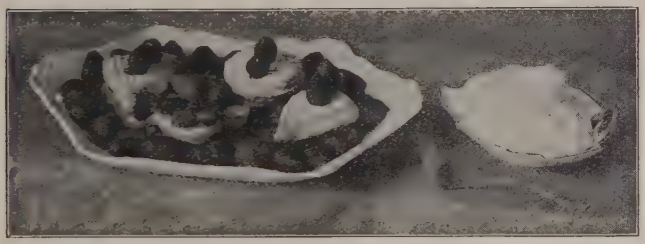
The use of cream in well-to-do families is increasing. Whipped cream is demanded as a garnish or sauce for many desserts quite complete in themselves.

The process of beating or "whipping" cream gives it an attractive appearance, and by expanding its particles probably makes it more digestible.

BUTTER

Butter is one of the most digestible forms of fat. An ounce of butter a day is a fair allowance for each person when meats, lard, olive oil, and cream are used. To test this in your own case, divide one ounce of butter in three portions, one for each meal, and see whether you naturally use less or want more. Or, this

may be tried in a family by shaping a portion of butter into balls with butter paddles and noting the amount consumed by each person at the table. An ounce of butter is easily secured by cutting a quarter pound pat into quarters. Or, if that is not available, measure the butter. Two level or one round tablespoonful is equivalent to one ounce. A pound of butter will measure one pint.



Individual Shortcakes to be Served with Whipped Cream.

Butter for Flavoring

Butter is probably rendered slower of digestion by cooking, and for this reason it is wiser to flavor foods with it after they are cooked. Often it is better to allow the individual eater to butter the broiled meat, or fish, or mashed vegetables, according to his own taste. Then there need be no waste if a portion of the whole dish is not eaten, and if the food is reheated the flavor is better.

In one dietary study of the Department of Agriculture of the United States (Bulletin 75 from the office of Experiment Station), so much butter came back in

the platters where it had been poured over steaks, chops, and fish, that it was assumed that none was consumed. Certainly, in every household considerable butter and other valuable fat finds its way to the dish water. One of the first steps in the application of science to housekeeping is to stop such needless waste.

Composition of Butter

In a glass measure cup, or a tumbler, put a quarter of a pound of butter, set the glass in a pan of warm water and leave until the butter melts.

Estimate the percentage of clear fat.

What other substances appear to be present?

How does this explain the sour and cheesy tastes sometimes noticed in butter?

White Sauce

Milk thickened by flour and made richer with butter and flavored, is known as milk gravy, drawn butter, or white, or cream sauce. It is a substantial food in itself and forms a valuable addition to fish, eggs, meats, and vegetables. By its addition a small portion of any food substance is extended and made to do more service, and flavors too pronounced to be agreeable to all are much modified.

There are several ways of compounding this sauce which apply to other sauces in which butter is the principal ingredient. A general formula covering the ordinary sauces—white, tomato, and brown—is this: one ounce of butter, one-half ounce of flour, and one-half pint of liquid; or, to express the same quantities in other terms, two level tablespoons of butter, the same of flour, and one cup of liquid.

Methods of Making

1. Melt the butter in a saucepan, stir in the dry flour, cook and stir until frothy all over, then draw to a cooler part of the stove and stir while adding the liquid hot or cold, then cook again till thick, stirring till smooth.

2. Another way is to rub butter and flour together and stir into the warm liquid in a double boiler, then stir till thick and smooth.

3. When thin cream is substituted for butter and milk, or when less butter is to be used, rub the flour smoothly with a little cold liquid and stir into the remainder, which should be hot, and cook over water until smooth. Then add butter and season.

The theory of the first method is that the butter attains a slightly higher temperature than the milk and if the flour is combined with the hot butter it is cooked more quickly and thoroughly than when put into milk.

In the second case, longer time is required, but the flavor of the butter is changed less than by the first method.

The third way is more economical of butter.

Brown Sauce

Butter is also used for brown sauces. These are made after the first plan for the white sauce, but the butter is allowed to brown before the flour is put in, and is cooked until a reddish brown hue is acquired before the liquid, which is usually brown meat stock, is added.

Varieties of White Sauce

In many other sauces the plan is similar to that followed in making the white sauce, but meat stock, strained tomato, or other vegetable stocks, are used in place of part or all of the milk.

These sauces are the foundation of many entrees or made dishes, such as croquettes and soufflés.

For meat or fish croquettes the sauce is made of a double thickness by using only half as much liquid. It is then combined with about an equal quantity of meat, seasoned and cooled, when the mixture may be shaped. Soufflés have the sauce as the basis and the puffy effect is produced by eggs.

Creamed Dishes

The usual white sauce, combined with an equal quantity of meat, fish or vegetable stock, gives us the cream soup, cream of chicken, cream of cod, cream of asparagus, etc., etc.

Since butter is not pure fat but contains water and curd, it is less desirable than other fats for greasing pans unless it is melted and the fat used alone.

Precautions in Using Butter

Except in cases when it is necessary to brown something quickly, butter should not be used for frying or or sautéing. It is too expensive and burns easily. Because of the quantity of milk, often sour, contained in butter, it is not strange that some recipes for rich cake call for small quantities of soda to balance this acidity. For such purposes, butter is frequently washed to remove milk and salt.

That butter responds quickly to changes of temperature should be remembered in mixing any dough,

like pastry, when a large proportion of butter is used.

Rancid Butter

Slightly rancid butter may be made usable for some purposes by scalding it in water, then chilling and removing the cake of fat on top. If further treatment is necessary the fat alone may be heated with bits of charcoal.

CHEESE

Composition

The origin of cheese is probably more ancient than that of butter. It is a form of dried or condensed milk convenient for transportation. Milk is nine-tenths water, while cheese contains but a trifle over three-tenths water. Average cheese is about one-third each water, fat, and casein.

Nutritive Value

A pound of cheese costing sixteen cents contains about twice as much nutritive matter as a pound of meat which will vary in price. There will be less waste in the cheese than in an average piece of meat. Moreover, cheese has the advantage of keeping better than the meat under adverse conditions. Its disadvantages are that because of its concentration it is not easy of digestion. This may be overcome somewhat by diluting the cheese with milk, as is done in many of the rarebits, fondues, and soufflés. The addition of a small quantity of bicarbonate of potash or soda aids in making cheese soluble. There is danger that the cheese will be over cooked. When merely melted it is probably quite as digestible if used moderately, as

many of our common ways of preparing meat. Judging from the types of people who depend upon cheese largely it might be used with us more generally than it is. The annual consumption of cheese in this country is only about three pounds per capita. We might well use cheese more freely in cooked dishes, for flavor as well as for nutriment.

TEST QUESTIONS

The following questions constitute the "written recitation" which the regular members of the A. S. H. E. answer in writing and send in for the correction and comment of the instructor. They are intended to emphasize and fix in the memory the most important points in the lesson.

PRINCIPLES OF COOKERY.

PART I.

Read Carefully. Place your name and address on the first sheet of the test. Use a light grade of paper and write on one side of the sheet only. *Do not copy answers from the lesson paper.* Use your own words, so that the instructor may know that you understand the subject. Read the lesson paper a number of times before attempting to answer the questions.

1. Give a rough diagram of the stove or range with which you are most familiar. Show where in the oven and on top of the stove the heat is greatest, and explain why.
2. What is your method of starting and regulating a coal fire?
3. Counting the time required to keep fire and stove in good condition, what is the most economical fuel within your reach?

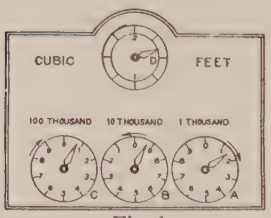


Fig. 1.

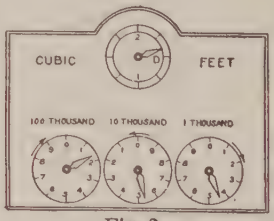


Fig. 2.

4. Fig. 1 represents the dial of gas meter at the beginning of the month; Fig. 2 at the end of

the month. What is the reading in each case, and what will be the amount of the bill at $1.25 per 1,000 feet of gas?

5. If you use a gas stove, read the meter before and after a day's baking and find the cost of fuel. If other fuel is used, give the amount and approximate cost.
6. Where, in your experience, would a thermometer be helpful in cookery?
7. Mention several foods requiring the action of heat, yet which need little preparation and few utensils.
8. What different ways have we of cooking with the aid of water?
9. Is it possible to cook in water that does not boil? Give examples.
10. What gain in cooking certain foods over, rather than in, water? Describe utensils by which this can be accomplished.
11. What kinds of foods should be kept in the refrigerator? Describe the refrigerator, or whatever is used in its place.
12. What are the essential points in canning fruit?
13. How should dried fruit and vegetables be prepared to restore them as nearly as possible to their original condition?
14. Are there any substances suitable to add to foods as preservatives?

15. What are the relative merits of paper bags, wooden boxes, tin cans, and glass jars for keeping groceries in pantry or store closet?
16. How can you determine for yourself that there is water and fat in milk, cheese, and butter?
17. Make a menu for meals for two days, introducing as many dishes as feasible that contain milk or cheese.
18. Suggest treatment and uses for sour milk, dry cheese, and butter of poor flavor.
19. Make a white sauce three times or more, putting the ingredients together in different order each time, and report which seems the most satisfactory and expeditious.
20. Are there any questions which you would like answered, relating to the topics taken up in this lesson?

NOTE.—After completing the test sign your **full** name.

PRINCIPLES OF COOKING

PART II

NEW ENGLAND KITCHEN OF THE OLDEN TIME

PRINCIPLES OF COOKERY

PART II

EGGS

Since the egg is similar to milk in composition, both containing water, fat, and protein, without starch, and as there are many simple dishes in which milk and eggs are combined, it is natural that that should be our next topic.

The egg may seem a small article to have much space devoted to it, but there is no other food so indispensable to the art of cooking. A French chef has compared the office of eggs in cooking to the usefulness of *the, an,* and *a,* in conversation, both would be difficult without them.

Usefulness of Eggs

Aside from its great food value, and there is no egg of bird that may not be eaten, the egg is a general harmonizer in the kitchen; it serves to thicken custards and sauces; to clarify soups and jellies; to make a coating of crumbs adhere to chops or croquettes; it puffs up soufflés; it leavens a whole group of cakes; it garnishes salads and emulsifies oil into a smooth, rich dressing for them, and combined with odd bits of fish or meat, it makes many a savory dish of what would otherwise be lost.

The composition of eggs varies with the kind of fowl and its food. The edible portion of the average hen's egg is nearly 75 per cent. water, 12 per cent. protein, 12 per cent. fat, and 1 per cent. ash or mineral matter.

Since carbohydrates are lacking, we naturally combine eggs with starches and sugar which supply the class of substance missing.

Like milk, eggs may be eaten either raw or cooked, and the ways of cooking eggs, however elaborate they seem, may be reduced to a few simple processes.

We shall have the key to all cookery of eggs if we study some eggs cooked by moderate and some by intense heat.

Effect of Heat on Eggs

To see how the egg is affected by different degrees of heat, we may poach several eggs, or drop them from their shells into water at different temperatures. When an egg is dropped into a saucepan with cold water, and heat applied, before the egg begins to cook, the egg and water mingle somewhat, showing that a portion of the raw egg is soluble in cold water. As the water is heated, this soluble egg becomes cooked and rises in a thick froth on top, and if the cooking is continued longer, this froth may contract and settle. This point is turned to the cook's advantage in clearing jellies, soup stocks, and coffee. Thus even the little portion of the egg white adhering to the shell is sometimes utilized for clearing coffee.

When an egg is dropped directly into boiling water, the outer portions of it are hardened by the heat. This cooked egg does not appear to be soluble itself and, moreover, protects the under portion until that also is penetrated by the heat.

Experiment.—Boil one egg rapidly; put another into the boiling water, remove from the stove, and let stand for fifteen minutes or more. Compare temperatures with a thermometer. See which egg is more tender, and presumably, more easy of digestion.

Temperature for Cooking Eggs

The white and yolk of eggs cook at different temperatures, and these appear to vary slightly with the freshness of the egg. For general use it is sufficient to remember that 150° to 180° F is ample heat for dishes composed mainly of eggs and milk. When starch is used, a higher temperature is required, and whenever possible, this should be obtained before combination with the eggs. Having learned this, we have the key to the successful cooking of all custards and the like. A custard that has curdled, or wheyed, or settled in the center, has cooked too long, or in too hot an oven. The custom of setting a custard in a pan of water in the oven is wise, for the moisture lowers the temperature of the oven. Excessive beating of eggs may aid the curdling of the custard; it certainly is a waste of effort here, however it may be in cake making.

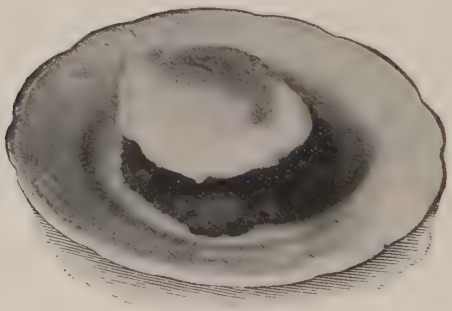
Custards

Average custards are made with three to six eggs to a quart of milk; naturally the larger number makes a firmer custard, but the other is quite palatable. Often

gelatine or corn starch is used to assist in thickening milk when eggs are expensive, but these combinations are not real custards.

Eggs with Starch

There is a long list of puddings where a custard or egg and milk are combined with starchy materials. In such cases as have already been stated, it is wise to have the starch, whether in the form of rice, tapioca, sago, or corn starch, cooked in the milk before the



POACHED EGGS ON FISH BALLS.

egg is added. Bread or cracker crumbs may be combined directly with the milk, for then the starch has already been cooked.

Dropped Egg

A single dropped egg may show that water need not boil in order to cook an egg. Even if a thermometer is not available, it can be seen that the white of the egg instantly changes in appearance when it comes in contact with water far below the boiling point. A muffin ring placed in the water assists in keeping the egg

in good shape. A little salt and lemon juice or vinegar in the water makes the egg harden quickly on the outside instead of mingling with the water.

Value

Since we reckon the cost of other foods by the pound, for easy comparison we must estimate the value of eggs on the same basis. It will be found that the average hen's egg weighs about two ounces, and that eight good sized eggs in their shells, or nine or ten shelled eggs, weigh one pound. The fuel required, the labor of preparation, and the waste are much less with eggs than for most other foods.

Some experiments recorded in "Eggs and Their Uses as Food" (Farmers' Bulletin No. 128, U. S. Dept. Agl.), show that it cost more than twice as much to serve and satisfy at breakfast a family of over one hundred women in a college boarding hall with mutton chops or beefsteak at less than 20c. per pound, than with eggs at 25c. a dozen.

Preserving

Commercially, there are many grades of eggs, dependent upon their age. Cold storage has done away with most other methods of preserving eggs. Anything that will exclude air, without bringing ill flavor to the egg, will aid in preserving it. Eggs are available almost everywhere at all seasons and even at their highest prices, are not more expensive than the choicer cuts of meat.

An inferior egg injures all other materials with which it is combined, therefore it is never economy to buy poor eggs. When eggs are high do without them.

making dishes which require few, if any; then when they are again plenty they will be all the more appetizing. With proper conditions for keeping eggs, it may be economy for some housekeepers to buy a large quantity in the fall and pack them carefully in an upright position, but many find it better to give the grocer a few cents more than to take the time and risk of loss.

COMBINATION OF EGGS WITH OTHER FOODS.

Any fundamental food, like the egg, must be served in a variety of ways or we tire of them. Foods having short seasons should be prepared in the simplest fashion.

Variety

The nutritive value of the food is not materially changed by a variation in the method of cooking, provided no additions are made to it. It may appeal more to the palate in one form than another, and the time of digestion may vary, though in the end as much may be absorbed in the one case as in the other.

Combinations to Reduce Cost

To illustrate this point, let us take two eggs costing at average prices two cents each, or four cents. Whether boiled in the shell or dropped from the shell into boiling water, their food value would be practically the same; when scrambled or made into an omelet there is a slight addition of nutritive material.

But the rigid economist says that eggs at two cents apiece are too expensive for the family of limited means. Then comes in the art of cooking to show how the eggs may be combined with less costly food ma-

terials to make several palatable dishes which may take the place of meats and yet require but little more labor in preparation.

With White Sauce

First, the two eggs may be combined with one cup of white sauce; this may be served with the omelet, or blended with the scrambled egg, or made into a souffle, or served with hard boiled eggs chopped or sliced.

The identical quantities might be used in each case. By such combination the cost of the dish is doubled, but it will go at least twice as far and its fuel value is more than trebled. Or, instead of the sauce, we may use one cup of milk thickened with white bread crumbs and well salted and omit the butter or use less. This will reduce both cost and fuel value.

With Cheese or Ham

The foundation may be again extended and varied. To the two eggs and cup of white sauce may be added two ounces of grated cheese or two ounces of chopped ham. If the ham is of average fatness, the fuel value of the cheese and ham will be about the same. The ham might be more expensive than the cheese were it not that this is a way to turn to good account the smaller bits of meat. By this addition the dish, at two and a half times the cost of the eggs, becomes about five times as efficient in fuel value.

Serving

This combination may be served in many forms,—the cheese may be warmed in the sauce and poured over the eggs hard boiled, poached or made into an omelet, and the ham might be used in the same way.

After mixing sauce, cheese, and yolks of raw eggs,

the stiff whites of the egg may be folded in and the mixture baked in one dish or several little ones.

All such combinations are naturally eaten with some form of bread, and here again the whole cost is diminished with an increase of fuel value.

A summary of these possible combinations may be clearer in tabular form, as follows:

	Weight.	Cost.	Cal.
2 eggs	4 oz.	4c.	161
White Sauce:			
1 C. milk	8 oz.	2c.	162
Butter	1 oz.	2c.	217
Flour	½ oz.		51
Cheese	2 oz.	2c.	246
Ham	2 oz.	2c.	207

It would be interesting to trace the history of egg cooking and find who first discovered that eggs cooked in milk, sweetened and flavored, made the palatable compound we know as custard; or who first discovered the delicious sponge cake or "diet bread," as our foremothers called it.

Sponge Cake

All our modern recipes for sponge cake, angel cake, lady-fingers, and sponge drops, are but slight variations from the recipes to be found in old cook books, which call for the weight of the eggs in sugar and half the weight of the eggs in flour.

The tendency of the artistic cook is to separate the two parts of the egg, using the yolk to produce certain effects and the white for others.

The proportions are about the same in the angel cake

as in the sponge cake, but the egg whites only are used. The egg yolks, left from such cakes, are more desirable than the whole egg for many custards and sauces, producing a richer and more creamy effect, since the yolk of egg contains considerable oil.

Eggs in doughs may better be studied here with other qualities of eggs rather than later with doughs. **Eggs in Doughs**

Under this head may be included noodles, popovers, Yorkshire pudding, cream puffs, eclairs, tim-

EGG TIMBALES.

bale cases, fritters of many varieties, as well as sponge and angel cakes and macaroons.

From a study of these distinctly egg doughs we may see why eggs are added to muffins, puddings, etc.

These may be divided into three classes: (1) When the egg is used merely to stick flour together, such as noodles and timbale cases. (2) When the cake resulting is to be hollow like popovers and puffs, then the egg is beaten with the other ingredients. (3) Where a spongy texture is desired, the eggs are separated and beaten separately. **Classes of Egg Doughs**

For such mixtures as the first class lightness is not essential, is really undesirable; hence, the eggs are

beaten only enough to blend yolk and white, and not to mix air with them. In noodles, which are a kind of egg macaroni, the egg supplies liquid as well as aids in sticking the particles of flour together. After a stiff, smooth dough is made, it is rolled much thinner than would be possible if it did not contain egg. Then it is

Noodles

Pop Overs—an Example Dough Raised by the Expansion of Air.

cut in strips or fancy shapes and may be cooked at once or dried and used like macaroni.

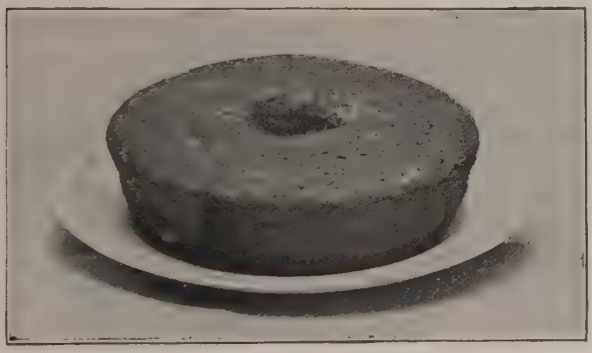
Timbales

The timbale cases are made from a thin batter, in which, to egg and flour, milk and small quantities of fat and sugar are added, and the whole beaten together until smooth. If the batter is then allowed to stand until the air bubbles escape, the timbale cases will have fewer holes in them. The hot timbale iron is then dipped into the batter and the coating adhering is fried until crisp.

The second class should be hollow, and to secure this result the eggs are beaten without separating yolk and white, or better still, are dropped in with the other ingredients and all beaten together.

Popovers are the result of a very thin batter, usually one cup each of flour and milk, one egg, and a little salt. This is beaten thoroughly together with a Dover

Popovers



SPONGE CAKE.

beater, poured quickly into greased cups, iron or earthen, and baked until thoroughly done. Yorkshire pudding is a similar combination.

Cream puffs have a cooked foundation of water, butter and flour; to this when cool the eggs are added and beaten into it one by one. Because of the scalding of the flour this is a stiff mixture and will keep its shape when dropped on flat pans, and will puff while baking. The same mixture, fried in deep fat, produces a hollow fritter which may be filled like a cream puff.

Cream Puffs

Spongy Mixtures

For the third class of egg doughs and for meringues and puffy omelets, the whites of eggs are beaten by themselves and mixed with special care into the other ingredients that none of the air which has been entangled may be lost. This air expands when heated, producing the delicate lightness of the meringue, or sponge, or angel cake.

Beating Eggs

The use of a whisk on a platter is the best way of quickly converting the slippery egg white into a frothy, flaky mass, so firm and dry that it may be turned upside down without slipping from the platter.

Egg beaters are not absolutely essential, for the work may be done with a fork in time. The whisks are best for beating whites alone—those with cog wheels for the whole egg or for beating batters.

When yolk and white are mixed, it is impossible to beat in as much air as into the white alone, probably because of the oil contained in the yolk. Even a very little of the yolk will prevent the whites from becoming a stiff froth.

Cooking

Popovers, meringues, and sponge cake, like other articles containing large proportions of egg, require long cooking at moderate heat. When taken from the oven too soon they shrivel out of shape.

It is not wise to make cheap cakes and try to make baking powder take the place of eggs in making the mass light. When eggs are cheap, make good cakes and custards, but when they are high in price, depend upon desserts where they are not required.

FISH, FOWL, AND FLESH.

Two important animal products, milk and eggs, have been studied, and we come now to a consideration of the flesh of animals as food. The cooking of the flesh in any way is a comparatively simple matter once we have mastered a few fundamental laws which are practically the same as in cooking eggs.

The choice of different sections of a creature for different purposes and the decision as to best ways of cooking whatever cut happens to be available, are less simple.

The primitive cook applied heat to his fish, fowl, or section of meat and consumed it when cooked. The modern marketmen first divide and clean, then the chef seasons and applies the heat in different ways to the various portions. One part is naturally tender and ready for immediate cooking, another will be better if kept a week or a month, others will be improved by salting or smoking.

Savages have fewer kinds of food and simpler methods of preparation than civilized man. Because of greater abundance it is a natural tendency in civilization to discard as refuse certain portions formerly eaten. On the other hand, business competition makes it necessary to save all by-products and every portion of an animal is used for some purpose and brings some money return, even though small. Were it not for this, our animal foods would be higher in price

than they are. As it is, they are the most expensive part of the daily food.

Meat a Secondary Product

This is partly due to the fact that the flesh of animals is a secondary product. Animals consume grains and require additional human care, and thus must cost more than the grains, themselves, alone. Moreover, it has been learned by dietary studies that average families in the United States obtain from half to two-thirds of the protein in their food from animal source, and the cost of food is usually proportionate to the demand.

Comparative Composition of Animal Food

The composition of all animal foods is similar. Milk is mainly water, but contains some of each of the food principles. Eggs have less water than milk, and no carbohydrates, but furnish larger proportions of fat and protein. Fish would average about the same proportion of protein as eggs, but rather less fat. Poultry yields more protein than eggs, but about the same amount of fat. The flesh of the larger animals will average about two-thirds water, the protein and fat being in varying proportions according to the age and condition of the animal.

Costs of Meat

Without regard to the names given by marketmen of different localities to the cuts of meat, we may learn the location of the choicest pieces. Cuts which offer tender muscle or large proportion of muscle will naturally command the higher prices.

In any of these animals the framework of bone is practically the same. The larger portion of bone is

in the forequarter. This is one reason why the forequarters are cheaper than hindquarters in our markets. Consequently, there is less nutritive value per pound and what there is is less accessible, for the meat is not easily carved unless boned before cooking.

Judging Meat

Meat of any kind should have little odor when in good condition. It should be firm and dry rather than

LAMB CHOPS AND KIDNEYS.

moist, and should be well marbled with fat.

The lower part of the legs will have little muscle in proportion to the bone, and there will be tendons holding the muscle to the bone.

Toughness

Muscles getting little motion or exercise will be tender, while those which are active will be tough, though juicy. The neck and legs, therefore, will be suitable for broths but not desirable for roasts.

A general rule is this: the market value of meat increases backward from the head, but decreases down-

ward toward the legs. This brings the choicest cuts in the back upper part of the creature and includes the rump and loin.

The muscle of good beef is dark red when first cut and grows brighter when exposed to the air for a short time. The fat is yellowish white.

Mutton and Lamb

Mutton and lamb have a hard white fat. The flesh of mutton is a duller red than beef. The lamb is pinkish in tinge. The bones of veal and lamb are smaller than those of beef and mutton. Veal and fresh lean pork are somewhat the same shade of dull pink, but the pork has more fat mixed with it.

Meat from young animals is tender but not so nutritious, and does not keep so well as that from older ones.

The heart, liver, sweetbread, kidney, tripe, are also used as food and the same general laws govern the methods of cooking them.

The chef may not recognize the same elements in meat that the chemist does, yet his choice and preparation of a cut of meat are based upon its composition. From this point of view, meat consists of three parts: lean muscle, fat, and bone, and the market value of any cut is based upon its relative proportion of these.

Lean meat is most desired and tender fibres command the higher prices. Some fat is utilized with the meat, but a large part goes to the manufacture of artificial butter, lard, and soap. Much of the bone is

refuse, but some of its substance may be extracted by right treatment.

The lean portion of meats is about one-fifth or twenty per cent. protein about five times as much as in an equal weight of milk.

Preparation

The muscle or the lean meat may be freed from skin, gristle, bone, and fat, wholly or in part before cooking. It is easier to serve when this is done, and there is no waste at the table, but there may be loss of flavor. Raw meat may be digested readily, but we cook it to make it more attractive in appearance and more appetizing in flavor.

Some Fat Needed

Some fat is required to keep the meat from drying during the cooking process. Often the muscle is so closely associated with bone, tendon, and gristle, that to remove them would cause serious loss of juice. In any case, when the tougher portions are removed they should be used for stock and their flavor returned to the muscle as a sauce or used for soup or other good purpose.

Tender muscles may be cooked quickly—steaks and roasts—and should be exposed to intense heat at first.

Tough Meat

Tougher portions may be made more palatable by pounding to separate the connective tissue, but this is often accompanied by loss of juice, or they may be put through the meat chopper or cooked slowly for a long time in a gravy, or both.

Browning

By browning tough meat first we give it a good flavor and sear the surface so that more of the juice will

be retained than if raw meat were used. Some scraps of fat may be browned, an onion sliced and fried in the fat, an equal measure of flour added, and when it is mixed smoothly with the fat, water is put in, in the same proportions as for white sauce. The meat is put in the gravy and left covered on the back of the stove to cook slowly, later vegetables are added.

Braising

Braised meat and pot roasts are similar in effect, but large pieces of meat are used and more time is required. All the trimmings, except the fat, are put with the bones, covered with cold water and the kettle is set on the stove to heat slowly.

Salt Meat

Salt meats should be cooked slowly in plenty of water until tender. When the meat is very salt, it should be put on in cold instead of boiling water.

Fatness

Wild animals usually are less fat than those that have been raised for food. Excessive fat may mean disease. Young animals have but little fat compared with older ones. Half the weight of a pig may be fat and a fourth of a fat sheep or ox. Some portions of a creature will contain much more fat than others. Layers of fat occur around the inner organs of animals. Some fish have fat or oil in the liver and little or none elsewhere. Fat mingled with the lean tissues is partly visible, partly detected only by chemical methods.

To a certain extent fat takes the place of water in the tissues. In fat meat the purchaser gets the same amount of protein but buys fat instead of water.

Saving the Fat

The surplus fat purchased with meats should be turned to good account by clarifying it for shortening or frying. It should be freed from the protein matter as far as possible by trimming and soaking in cold salted water. The water should be changed often, and the fat, after being cut in small pieces, may soak from twelve to twenty-four hours. Then it is drained and

SAUSAGE AND FRIED APPLES.

heated slowly to separate the clear fat from the heavy, honeycomb-like tissues which contain it. At the end of several hours the fat will have melted and may be strained from the crisp brown tissues. If raised to too high a temperature the fat is less wholesome and well flavored.

In the average household, trimmings of beef, pork, veal, lamb, and poultry, may be prepared together for

fry fat, and where much meat is used will keep a supply in the frying kettle.

Frying in Deep Fat

Frying in deep fat is a satisfactory method of securing a crisp, brown crust. When the process is properly conducted very little fat is absorbed by the food.

The temperature of fat suitable for cooking is much higher than that of boiling water and ranges from 300° to 400° F, according to the nature of the article to be cooked. For doughs which should rise, and fish which must be cooked through, a lower temperature and longer time are required than for fishballs or croquettes, already cooked and only to be browned.

If many pieces of cold food are put into the kettle of fat at one time, the temperature will be lowered so much that they may absorb fat and even fall to pieces.

Testing Temperature

A bit of bread dropped into the kettle will brown in one minute if the fat is right for frying doughs, and in less time if it is ready for croquettes.

Fat by itself does not boil, but when moist food is put into it large bubbles of steam begin to form. At first the foods being cold and heavy sink to the bottom of the kettle; as they warm and the water escapes, they rise toward the top.

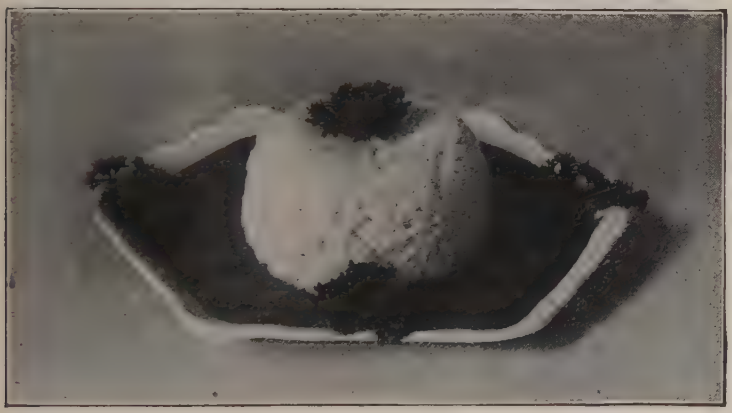
As soon as the food is brown it should be removed from the fat and drained on soft paper before serving.

Bones

The bones of animals yield considerable nutritive material if we use proper methods to extract it. Mar-

Extracting Nutriment

row is found in the leg bones, but they have not so much protein matter as the spongy rib bones. When meat is boned before cooking, bits of meat cling to the bone. By soaking in cold water, then cooking gently, a large part of the flavor and nutritive part of the bone is dissolved in the water. Cartilage, gristle

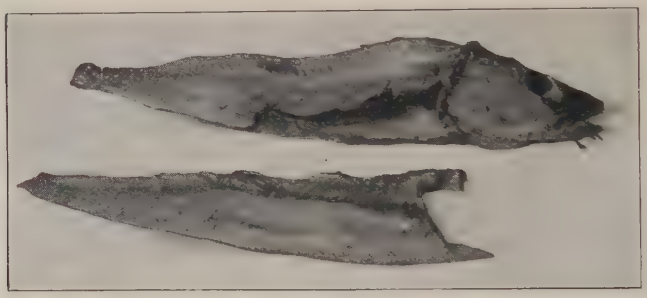


MEAT LOAF IN RICE.

and tendons are also somewhat soluble when exposed to moisture and heat. The smaller the pieces into which bone and meat are divided the greater the surface exposed to the dissolving action of the water. The flavors of meat which are drawn into the water are known as extractives and are stimulating rather than nourishing.

Soup Stock

This process of extraction from portions unsuitable to eat is known as making soup stock. Bouillon and beef tea are made from tough lean meat with little



FILLET CUT FROM SIDE OF FISH.

or no bone. Consommé is made from meat and poultry together. Anything that would give a strong flavor must be removed. The skin of lamb or beef should be thrown away.

Names of Soups

The flavoring of the soup or the garnish served in it gives its distinctive name. All meat, poultry, and fish soups have as their basis a stock made from the portions undesirable to use in any other way.

Yet stock contains but a small proportion of the nutriment of the meat, and fibre of the meat from which stock has been made may be used for hashes, with herbs, etc., to give flavor.

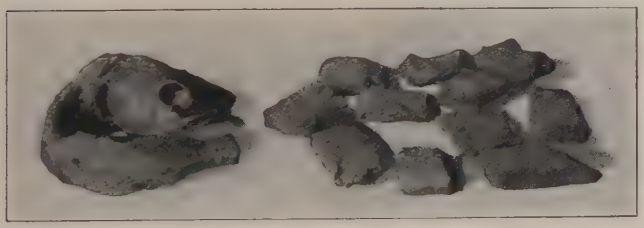
FISH.

Proper Appearance

Fresh fish have full lifelike eyes, red gills, silvery, not slimy skin and scales, firm tail, not flabby and drooping, and firm flesh. Plump short fish are better than long thin ones of the same variety. The time of their transfer from the water to the table should be as short as possible. While fish as a whole is not so nutritious as meat, it may often take the place of meat on our tables. It is the province of the cook to supplement the fish with such sauces as will supply both flavor and nutriment.

Methods of Cooking

In general, the methods of cooking fish are the same as those followed in cooking meats. The flesh should be thoroughly cooked, but not overdone. Oily fish, like



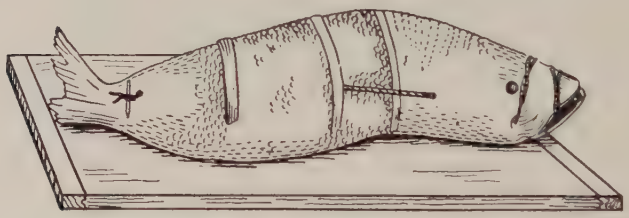
PREPARATION OF FISH.

For Fish Stock. Ready to Fry.

salmon and mackerel, are best broiled. Almost any fish may be baked whole or in fillets. Boiling is an extravagant method of cooking unless the water is used for a soup or a sauce. Steaming is better than

boiling, as more of the flavor is retained in the fish. Frying in salt pork fat is a desirable way to cook fish lacking flavor or fat, but for uniformity in cooking the kettle of deep fat is to be preferred to the thin layer in a shallow pan.

If a fish lacking in fat is brushed over with oil or melted butter and broiled under gas, the result gives the best effects of frying without the disagreeable odors.



FISH STUFFED AND TRUSSED FOR BAKING.

Fish stock may be kept for several days if convenient, or it may be used as the basis of a sauce to serve with the fillets of the flesh.

Sauces with Fish

Since so many varieties of fish lack fat, rich sauces are generally considered a necessary accompaniment. The composition of the fish and the way in which it is cooked should decide the kind of sauce to be served with it. Acids like lemon juice, pickles, and tomato are often agreeable additions to a fish sauce.

POULTRY

Judging

Young birds are to be chosen for broiling and other quick cooking, but full grown fowls are more nutritious for broths and stews. A fowl is usually fatter than a chicken, the skin is tougher, and the bones—especially the tip of the breast bone—are harder. In the skin of the young bird there are usually pinfeathers, the feet are smoother, and the muscles or flesh are less well developed than in the fowl.

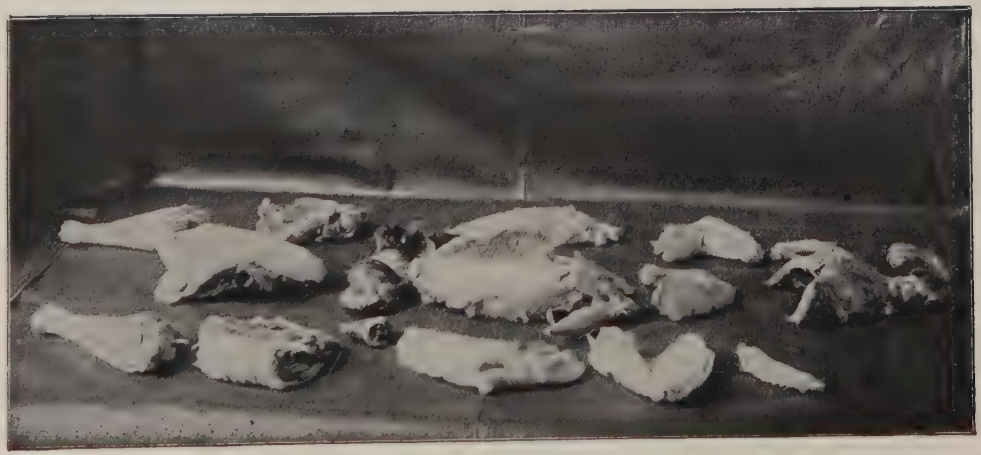
Preparing Fowl for Fricassee

To prepare poultry, pick out pinfeathers, singe and rub off the hairs and wipe clean. Cut through the loose skin on the back, pull away from the neck, take out the crop and windpipe in front, cut off the neck.

Cut through the skin on the legs about an inch below the joint, break the bone, twist the leg and pull out the tendons one by one. Take off the wings and cut through the loose skin on the sides and separate the leg and thigh joints.

From backbone to tip of breastbone cut through thin muscles on either side. This exposes the interior organs so that it is easy to learn their relative positions. Then one knows how to proceed when preparing a bird to roast when the opening is small.

Loosen the membranes which attach these organs to the body, following the breastbone with the fingers until the point of the heart is felt. Then remove heart, liver, and gizzard together. The gallbag is protected by the liver, so there is little danger of breaking it if



A FOWL CUT UP FOR FRICASSEE.

they are not separated. The intestines should be removed when the fowls are dressed for market.

Next detach the lungs from the backbone near the wings, and the kidneys, which are lower down in the back. These are not used.

Separate the gallbag from the liver without breaking, and cut away any portions of the liver which are tinged with green. Cut across the larger end of the heart and slip it out of the membrane enclosing it. Cut through the gizard on the wide side and take out the inner portion without breaking, if possible.

Order of Removal

Learn the order of removal of these portions from the body, and then nothing will be forgotten when preparing a bird for any purpose,—the crop and windpipe from the neck.

The heart, liver, and gizzard, together, from an opening near the tail.

The lungs and kidneys from the hollows in the backbone.

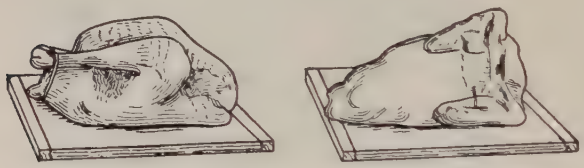
The oil bag on the upper part of the tail.

The backbone can now be divided near the middle, and by slipping a knife under the sharp end of the shoulder blade and then cutting through the ribs from the point where the wings come off, the upper part of the back is separated from the breast.

If desired, the fillets of white flesh can be separated from the breastbone and wishbone by running the knife close to the bones.

Never soak a fowl in water, as is often the practice. If any parts need washing rinse them off quickly one by one.

The breastbone, upper part of back and neck, and sharp ends of wings should be put in cold water and



CHICKEN STUFFED AND TRUSSED FOR ROASTING.

heated slowly; thus more flavor is extracted from these portions which have but little meat.

Put in Boiling Water

When the water is boiling hot the other sections are put in and the hot water coagulates the juices on the outside and thus more flavor is retained. To accomplish the same end, the joints are often browned in hot fat and then are stewed afterward.

VEGETABLES AND GRAINS.

Like the foods already studied, vegetables are mainly water, but all the five food principles may be obtained from the vegetable kingdom. Here we secure our supplies of starch and sugar, or the carbohydrates, but the proportions of proteid and fat are, as a whole, smaller than in the animal foods. From fruits, vegetables, and grains we obtain mineral substances valuable for making bones and teeth and keeping the whole system in good condition.

Softening Cellulose

The woody fibre or cellulose, abundant in vegetable structures, is the great obstacle to be overcome by cooking. Plants growing rapidly with plenty of water and sunshine usually have less of this fibre, and it is the aim of the gardener to eliminate it as far as possible. By improved methods of cultivation the agriculturist has removed the acrid flavors of the natural vegetables and has reduced the proportion of woody fibre.

The cell walls cannot be separated wholly from the nutritive substances they contain, and unless softened by cooking may irritate the alimentary canal so that the whole is hurried through before digestion is completed. Cellulose, though of little food value, may aid digestion by providing the necessary bulk for its mechanical processes.

Experiment. To get a clear idea of the structure and composition of vegetables, grate a portion of a

potato or turnip. Let the pulp fall from the grater into a strainer placed over a glass and press out all the watery juice possible. Some of the starch of the potato will settle from the juice, and more may be washed out of the mass remaining in the strainer. The presence of sugar in the juice of a carrot may be recognized by tasting it after evaporation.

By examination of the woody fiber left in the strainer we see how closely it is connected with the starch and sugar, how impossible it would be to separate it, and the necessity for softening it that we may be able to digest the nutrients.

We discard portions of vegetable foods, the pods, husks, cobs, etc., because of our inability to cook them so they can be digested.

Chopping and straining aid the cook in dividing the cellulose so that the particles are less irritating and the nutrients are more accessible.

Parts of Plants Used for Food

It is interesting to note the different parts of plants which are used for food—the roots, tubers or bulbs, stems, leaves, fruits, and seeds. The last are used mainly in the dry form, and absorb much water in preparation. This must be remembered when studying analyses of dried legumes and cereals.

The botanical grouping of plants is helpful. Once we have learned how to prepare and cook one member of a plant family we have something to guide us with its relatives. Among the principal classes to study in

this way are the pulses, the grains, and the cabbage family.

There are many kinds of each vegetable offered by the seedsmen. Moreover, any vegetable differs materially in different years and at different seasons of the year.

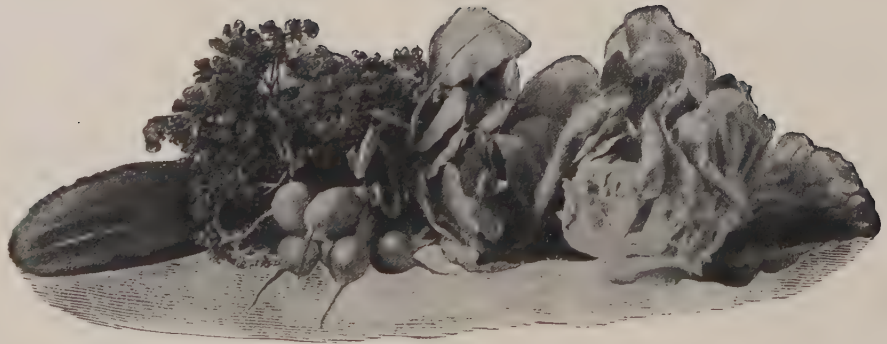
From the standpoint of the cook a convenient classification of vegetables may be made according to the general preparation, the time, and the amount of water required for cooking them.

Dried Vegetables

Dried vegetables must have abundant water supplied and must be allowed time to soak, thus absorbing an amount of water similar to that lost in the drying process. There is little difference aside from the fat added in cooking, in the analysis of the dry bean which has been soaked and baked, and that of the green shelled bean. Sometimes we try to hasten this process of absorption by heat, but the best results are attained when dried fruits or vegetables are soaked until at least double in size before cooking.

Strongly Flavored Vegetables

Old or strongly flavored vegetables, such as potatoes, turnips, and onions, will be improved by the removal of the skin and any imperfections before cooking, and by soaking in cold water for an hour or two. Inferior onions may be scalded in soda water before cooking, and by changing the water once or twice during the cooking process will be rendered less strong in flavor. It is wiser to make the vegetable palatable



SALAD PLANTS.—Cucumber, Parsley, Radishes, Cabbage, Lettuce.

at the risk of some loss of nutriment than to retain everything and have it uneatable.

Young vegetables in summer and those having sugary juices, like squash and beets, should be cooked in little water or by steaming or baking, so that all their sweetness may be retained, unless the water is reserved for soup or used in a sauce for the vegetable itself. **Young Vegetables**

Slightly wilted vegetables may be improved by washing and soaking or by wrapping in a damp cloth and placing in the refrigerator or by hanging in a draft of air. **Wilted Vegetables**

The pulses or leguminous plants include the bean, lentil, pea, and peanut. **Pulses**

In the bean we have an example of a vegetable which differs much at different stages of growth. We may use the pods before the seeds they contain have reached their normal size, the full grown seeds may be cooked green, or dry after first being soaked.

This class of plants is of great value where people must be fed at small expense. They are staples in in China, Japan, Southern Europe and Mexico, are invaluable in prisons, charitable institutions, and for the pioneer or logger. Because they lack fat, cream, butter, or pork are added before eating.

Some varieties like the Japanese soy beans, contain as much as sixteen per cent of fat, and peanuts are more than one-third, or about forty per cent fat. **Fat Contents**

Digestibility

Though rich in nutrients this class of vegetables appears to be slow of digestion. The ease and completeness of digestion are aided by thorough cooking and by removing the skins, grinding, mashing, or straining. Long, gentle cooking develops new flavors and removes the peculiar granular texture present in beans and peas insufficiently cooked, even after straining.

Black Bean Soup, Garnished with Lemon and Parsley.

The main object in cooking beans, like all vegetables, is to soften the tough fibres of the pods of the string beans and the skins and cellulose of the dry ones.

Peas

Split peas have the skins removed and thus are more readily digested. The skins of the larger beans may be rubbed off after soaking and parboiling.

Hard water retards the cooking of beans and a bit of soda is often added to soften the water and loosen

the skin—this water is poured off when the beans are partly cooked.

Few people use the variety of beans they might, as the black beans for soup, the limas or red kidney for stewed beans, the pea bean and yellow eye for baking and the French flageolets for salads. Beans

Potatoes are generally liked because of their lack of pronounced flavor, and for the same reason, may be combined with many other foods. Potatoes

A peck of potatoes may cost from fifteen to seventy-five cents, according to the season of the year, and the abundance of the crop. This quantity will weigh fifteen pounds and will average from fifty to sixty potatoes. That is, one pound will be about four potatoes of medium size, and will cost from one to five cents.

If pared before cooking and all bad places removed, average potatoes will lose from twenty to twenty-five per cent, or one of the four potatoes in a pound. From selected potatoes the government experts scraped the skins, removing as little flesh of the potato as possible. This was about eleven per cent of the weight. In potatoes as usually purchased, the green ends, decayed places, and the potatoes gashed with the hoe easily bring the total loss up to the higher percentage. Loss in Preparing

It may be a profitable loss to pare old and inferior potatoes before cooking. The main point to notice in the cooking of the potato is to let out the steam, or to

pour off the water as soon as the fibre and starch are softened.

Potatoes with Meat

Because the potato is lacking in protein and fat, the instinct of man has taught him to eat it with meat, since it gave him the food principles the meat lacked, and also the bulk desirable for the process of digestion.

The art of the cook has devised many methods of combining butter, oil, milk and eggs with the potato and other vegetables to supply protein and fat. The fried potato absorbs fat while cooking; the white sauce of creamed potato adds both fat and protein; a potato soup is creamed potato with more milk; the potato croquette contains egg and is cooked in fat; a potato salad has oil and often eggs.

Such additions, though increasing the cost of the food, make the result equivalent to vegetables with a moderate allowance of meat. Hence vegetable soufflees, or croquettes, may be served when the meat supply is limited.

Combinations

Almost any vegetable, by due combination with milk, butter, and eggs may appear as soup, fritters, croquettes, soufflees, or salads. For these complicated dishes, it is essential that the vegetable first shall be perfectly cooked in a simple fashion.

Cooking Vegetables

The methods of cookery applied to vegetables are similar to those used for meat, but must be adapted to the composition and condition of the individual specimen.

It is impossible to give the exact time for cooking any variety of vegetable, for every sample will differ. They are unpalatable when underdone and also at the other extreme.

There is usually some way of cooking best for each vegetable, but if one kind only is available it is necessary to serve it in a variety of ways. This, perhaps, explains why the average cook book gives more receipes for the potato than for all other vegetables. Suitable utensils are essential; vegetables should not be cooked in iron kettles when others are attainable; strainers, mashers, cutters, ricers and presses are desirable.

Preparation

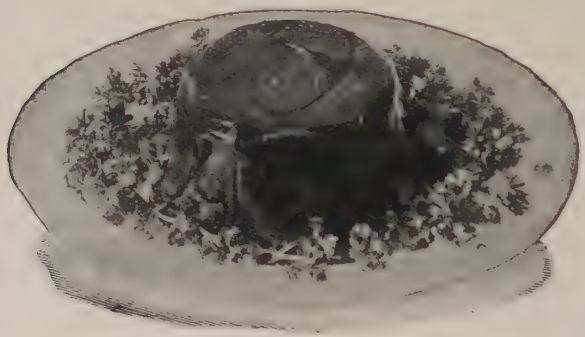
Strong flavors frequently are due to careless preparation. Careful trimming and thorough washing are essential. Wilted vegetables are improved, as has been said, by soaking. Salad plants need especial care in washing to remove parasites and insecticides.

Any portion of a root or tuber grown above ground becomes green and strong flavored and will impart its flavor to other portions with which it may be cooked. A decayed bit, or the scorching where the water evaporates, may often ruin the flavor of all.

Young, tender, well flavored vegetables should be cooked and served in the simplest manner. Inferior specimens, like tough asparagus or celery which has lost its crispness, by boiling, straining, and flavoring may be made into palatable soup when they would be worthless under simple treatment.

Vegetable Soups

Vegetable soups are of two types;—for one, the vegetables are cooked till tender, cut in convenient bits and added to a meat stock. For the other, by long cooking in water a single vegetable or several together are made into stock, and all that is soft enough is rubbed through a strainer and then put with about an equal quantity, according to the strength of each, of



TOMATO JELLY WITH BEETS.

meat stock or thin white sauce. Thick, pulpy stock, like that from peas, beans, or potatoes, needs a much thinner sauce than would celery or asparagus. Unless some thickening of flour is used, the solider portions will settle, leaving the soup watery on top.

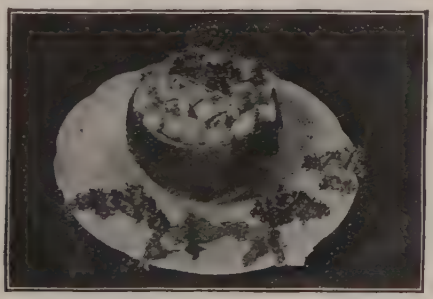
Preparation and Digestibility

In one of the publications of the United States Department of Agriculture the difference in digestibility of the same food cooked in various ways is thus stated: Whole peas soaked and cooked, 60 per cent digested;

peas cooked a long time and strained, 82.5 per cent; pea flour cooked with milk, butter and eggs, 92 per cent. This would seem to prove that the portion of vegetable food considered undigestible can be reduced by right methods of cooking.

Mashing

Mashing is a form of preparation suited to squash, turnip, parsnip, and potatoes. A seasoning of cream,



INDIVIDUAL APPLE AND CELERY SALAD.

or butter, and salt and pepper, is usually added. Fritters and croquettes usually have mashed vegetables as their foundation, or small bits are mixed with a thick cream sauce.

Creamed Vegetables

The white sauce is a useful additon to vegetables since it increases their nutritive value and modifies strong flavors. Almost any cooked vegetables may thus be "creamed" or "scalloped" by adding both the sauce and buttered crumbs and baking. This is an excellent way to reheat something left from a previous day.

Salads

Salad is a term belonging especially to a class of uncooked vegetables and in all cases implies a vegetable foundation though meats or fish may be added. The dressing of oil and vinegar is likewise of vegetable origin.

Here is another of our attempts to bring together the five food principles in a single compound. Water and mineral matter, protein, fat, and carbohydrate are usually blended in fairly balanced proportions. This is especially true of salads containing eggs, fish, or meat and eaten with bread.

GRAINS

The grains or cereals are the main dependence of the human race for food and have been known from very early times. Some member of this family of plants is found in every section of the world. Rice, wheat and corn are most largely used as food, while oats, rye, barley, and millet follow closely. Animals can eat these grains or grasses as they grow. For the human stomach the coarser portions must be removed. All are similar in composition, being from two-thirds to three-fourths starch. The protein ranges from 7 to 15 per cent; fat varies from 1 to 10 per cent; there is about 1 per cent mineral matter and 10 to 12 per cent of water.

Addition of Water

Before we can eat and digest such foods a large amount of water must be combined with them. Analyses have shown that the percentage of water in mushes,

boiled rice, macaroni, and mashed potato is nearly the same.

When we buy cereals in paper packages we pay a little more for them than when they are bought in bulk, but that is a convenient, clean form in which to keep them. All cereals should be looked over before cooking since they are liable to attacks from insects.

A Cup of Corn Meal, and the Amount of Mush It Will Make.

Mushes.

To make mushes start with the desired proportion of liquid, as that regulates the final amount. If too much water is used it can seldom be drained off, as it might be from potatoes, and if there is too little at the beginning it is practically impossible to add more without making the mush lumpy and pasty. A double boiler, a dish set in a steamer or a covered pail in a kettle of water, are the utensils suitable for cooking mushes.

Cooking Cereals

The coarser the grain, the more water required, and the longer will be the time of cooking. Whole grains are improved by soaking in cold water, finely ground preparations must be mixed with cold water to prevent the formation of lumps. All others should be put into boiling water. Add one teaspoonful of salt to each quart of water. Ordinary oatmeal and granulated wheat need four times their bulk of water, cracked wheat and hominy require more. The rolled grains require but twice their bulk of water.

The cooking at first should be rapid and the upper part of the double boiler should be placed directly on the stove for five minutes. Then put it over the other part, cook closely covered and do not stir. Such foods are not injured by cooking for a longer time than the usual directions allow. Coarse hominy, oatmeal, or cracked wheat for breakfast should be cooked several hours the previous day.

Rice

Rice may be boiled in a quantity of water which is afterwards drained off, but this is wasteful unless some use is made of the liquid.

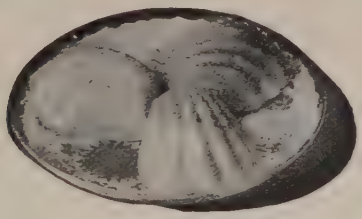
Macaroni and tapioca are not strictly cereals but conform to the same rules of cooking.

Fried Mush

Most mushes or cooked cereals may be moulded and served cold for variety, especially in warm weather, or be packed smoothly in oblong pans or round tin boxes and when cold sliced and fried to serve with syrups or to eat with meats.

A portion of cooked cereal may be added to the liquid used in mixing muffins.

Manufacturers of the present day seem to be trying to see in how many different forms they can prepare the few standard grains; they are left whole, are cracked, are crushed into flakes, or broken into granules. As the result of this variety of preparations and



Cereals shaped in Fancy Moulds.

the generous way in which they are advertised cereals are used more and more.

"Ready to Eat" Cereals

During the last few years they have been cooked in the factories and prepared in forms ready for immediate use. These forms have many merits though not all that are claimed for them. In some respects they resemble the primitive forms of unleavened bread which were the first attempts among all races, the bannock, the hoe cake, the tortilla.

PRINCIPLES OF COOKERY.

PART II.

Read Carefully. Place your name and address on the first sheet of the test. Use a light grade of paper and write on one side of the sheet only. *Do not copy answers from the lesson paper.* Use your own words, so that the instructor may know that you understand the subject. Read the lesson paper a number of times before attempting to answer the questions.

1. In what ways are eggs used in cookery?
2. What substances are naturally combined with eggs and milk, and why?
3. What is the fundamental principle in cooking articles containing a large proportion of egg?
4. Mention five dishes where egg is an essential ingredient, and five others where it may be used or omitted. Explain why.
5. If we find it necessary to reduce the number of eggs in a cake or custard, what other changes would be necessary?
6. Make a two days' menu for the season when eggs are at the lowest price, and two days' menu for the season when they are expensive.
7. Which forms of animal food are the most expensive and why?
   Which most economical and why?
8. What portions of meat are best for soup stock? What should be discarded? Describe the process of making soup. Has the extracted meat nutritive value?

9. Why is less fat absorbed by food in frying in deep fat than in sautering?
10. Give methods of preparing tough meat so that it is palatable and nutritious.
11. Give the names of soups which have (a) little, (b) much, and (c) great nutritive value.
12. Why do we add stuffing and sauce to meats and fish?
13. What is the greatest obstacle to be overcome in cooking vegetables?
14. Give methods for cooking fish. What is the proper appearance of a fresh fish?
15. Plan a rotation of different cereals for five breakfasts in winter and five in summer, giving reasons for your choice.
16. How may different methods of preparing a vegetable change its nutritive value?
17. Describe your own method of roasting meat.
18. Give the names of the vegetables and grains used in your household. Name some that are not used.
19. Is there any question you wish to ask or subject you would like to discuss relating to this lesson?

NOTE.—After completing the test, sign your full name.

PRINCIPLES OF COOKING

PART III

STEAMED PUDDING, CHRISTMAS DECORATIONS

PRINCIPLES OF COOKERY

PART III.

BREAD AND OTHER DOUGHS

Order of Mixing Ingredients

Having considered the whole grains we must learn how to use them when ground into flour. Although some forms of bread like hoe cake and tortillas can be made from cracked grain without making it into a flour, most people depend upon flour for a large part of their daily food.

In the best cook books the ingredients are mentioned in the order in which they are to be put together to secure the best results and to save dishes; the dry cups and spoons are used for the flour and spices, then for the shortening and liquids. The flour is sifted before measuring and sifted again to mix the other materials with it.

General Proportions in Doughs

There is such variation in flours that it is impossible to give exact recipes for doughs, but it is easy to learn certain general proportions and experience must teach the rest. A simple formula will be helpful in interpreting old recipes in which the exact quantities of flour or liquid are not stated, or in analyzing recipes to decide whether they are doughs or batters.

One measure of flour to one of liquid makes a batter.

Two measures of flour to one of liquid gives the usual muffin mixture.

Three measures of flour to one of liquid makes a soft dough, but one that may be kneaded.

Four measures of flour to one of liquid is the usual proportion for doughs to be rolled thin like pastry or cookies.

Batters and muffins can be stirred with a spoon. Doughs are mixed more thoroughly and easily with a knife.

Doughs are made light because thus they are more palatable and digestible.

Making Doughs Light

The almost endless variety of breads, cake, and pastry may be classified according to the means used to make them light. Yeast has been known to the human race from a very early period, the others are much later inventions.

The principal means are these:

The mechanical introduction of air, as by beating or by the addition of eggs or by the folding of pastry, or in the aerated or Daughlish bread.

The use of yeast, the growth of a plant filling the dough with gas.

The chemical combination of a bi-carbonate of soda, with some acid substance.

Yeast

For practical use in every-day life it is essential to remember that yeast must be treated like other forms of plant life and if we want it to grow, we must provide the right kind of soil, sufficient moisture, and suitable temperature. After its work is done, the vitality of the yeast must be destroyed by heat.

Yeast Cakes

It may be desirable to know how to manufacture yeast at home and how to utilize the dried yeast cakes in emergencies, though compressed yeast cakes are now so generally used that it is hardly necesary. A compressed yeast cake should be firm and solid, not soft and pasty; it should look something like fresh cheese, not dark colored and moldy. When only part of a

USEFUL UTENSILS.

yeast cake is to be used, it should be cut off squarely and the remainder wrapped smoothly in tin foil again, when it may be kept a few days longer.

BREAD

The essential ingredients in bread making are yeast, liquid, and flour; the proportions may be varied according to conditons.

Sugar and shortening are commonly used, but if they were omitted wholly it would be possible to have palatable, nutritious bread. Salt is essential to suit the taste of most persons, but as bread is usually combined

with salted butter its absence would be less noticeable, and bread might be made without it. Fermentation is hindered by the presence of salt, a small amount of sugar hastens the process.

Causes of Slow Rising

Sugar in large quantities makes the dough dense and the yeast cannot expand so readily. An excess of shortening has much the same effect. If a dough is made stiff with flour it rises more slowly. A stiff dough usually has small air cells and is finer grained than when the dough is made softer.

The liquid may be milk, whole or skimmed, or water, or half of each. The milk supplies some sugar, fat and nitrogenous matter and produces a more nourishing loaf than that which is made with water. Mashed potatoes or sifted squash or cooked cereals are sometimes added to a bread dough for variety, but the process is not changed by such additions.

Kinds of Flour

The best bread flour is made from spring wheat and pastry flour from winter wheat, though they may be used interchangeably if necessary. The spring wheat flour contains more gluten and less starch, so that less of the bread flour is required to produce a dough of a given consistency.

The entire or whole wheat flours provide more bone making materials than white flour, otherwise there is little difference in the nutritive value of the better grades of each.

The presence of gluten makes wheat the favorite flour for yeast dough. Gluten is adhesive when moist-

ened and thus retains the gas bubbles formed by the yeast in somewhat the same way that egg-whites hold air when they are beaten.

Order of Mixing

Old recipes for mixing yeast bread usually give directions for rubbing shortening into the flour and then

"BREAD CAKE" OR BUN BREAD.

adding the other ingredients with liquid to make a dough that can be kneaded. The best authorities today reverse the order, thus saving time and energy and producing a better result.

Liquid Warmed

The liquid is warmed that the fat, sugar, and salt may readily blend with the other ingredients and that the dough may rise more rapidly. When it is below 100 F, or cool enough to avoid cooking the yeast, that

is added and well mixed through the liquid. Sufficient flour then is mixed in to give the desired consistency for kneading.

At first the mixture may be stirred with a spoon, but as it becomes stiffer a knife will more easily serve to produce a smooth dough.

Double Process Bread

The process of mixing bread may illustrate the batter and drop batter or muffin mixture as well as the dough. To make a sponge, half the quantity of flour to be used is mixed with the liquid and this allowed to rise till foamy, when the remainder of the flour is added. The advantages of this double process are that a trifle less flour is required since the first has time to expand before the second is put in, and that the process is somewhat shortened because in the first stage there is less resistance for the yeast to overcome and the whole sponge becomes full of yeast for the second stage.

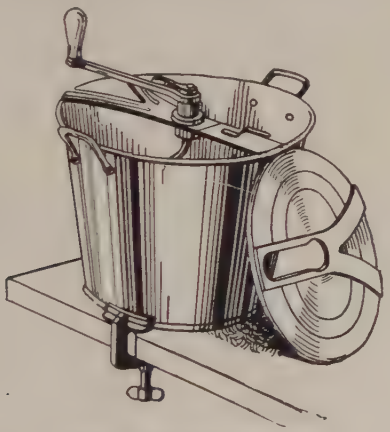
Amount of Yeast

Sometimes it is more convenient to use a small portion of yeast and allow the dough to rise for a longer time, and again to use more yeast and thus do the work more quickly. Until the scientists decide which is really the better method, the housekeeper will find it desirable to vary the quantity of yeast according to her conditions. Time, temperature, and quantity of yeast must be considered,—if one must be diminished, the others should be increased.

Short Process

For common use, a short process is to be preferred to the old custom of letting the dough rise over night.

When it rises by day we can regulate the temperature and stop the process at the right time. One yeast cake to one pint of liquid and about three pints of flour, will make two medium-sized loaves of bread, which can be completed inside of six hours.



BREAD MAKING MACHINE.

Holding Dough in Check

When necessary, a dough well risen and ready to shape may be cut down and put in a refrigerator or other cold place and thus held in check for several hours without injury. Sometimes half the bread may be shaped in a loaf and the remainder in rolls and the pans containing the latter set away in a cool place for several hours before baking that they may be hot for a later meal.

Rising

When first mixed, dough is kneaded just enough to blend all ingredients, then it is put back in the bowl,

brushed over with water or with melted fat and covered while it is rising. Such precautions aid in preventing the formation of a dry crust caused by the evaporation of the water on the surface during the process of rising. The bowl containing the dough may be set in a pan of warm water which is changed often enough to keep the temperature even. When the dough must stand over night in a cool kitchen, the bowl may be wrapped in a blanket to prevent the escape of heat.

Kneading

Much time is doubtless wasted in kneading doughs, though it seems to be agreed that this process works all ingredients together and thus give a better texture to the bread. To knead work the edges of the dough little by little toward the center, pull it over, press down into the mass and press it away with one hand while turning the whole around with the other. When the dough is smooth, elastic, and rises quickly when pressed and does not stick to the hand then it is done.

After the dough is double in bulk it should be kneaded enough to redistribute the air bubbles which have run together and formed larger ones, and to shape it for baking. At this stage no flour should be added, for here much time would be required to work in a little flour, and that is why long kneading has been thought necessary. Dip the fingers in soft fat if the dough inclines to stick, as one would do when pulling candy.

Shaping

To shape biscuits or rolls, first make smooth round

balls, then by gentle rolling and pressure make the finger rolls—then farther extend till the strips can be twisted or left as sticks for soup. Thus one form may be developed from another.

When rolls are to be cut out and folded, the pressure of the rolling pin will equalize the air bubbles without previous kneading. Instead of making the dough for rolls rich with butter or lard, it is wiser to brush over the outside of the rolls with melted fat when they are put in the pan.

BUNS—SEPARATE AND IN LOAF.

Again the dough must be allowed to double in bulk and then it is ready to bake.

Summary

To summarize the points already covered.—The time required depends upon the quantity of yeast used, and the temperature at which the dough is kept. One measure of liquid to three of flour is the usual proportion. For fancy breads make a sponge first, and let the mixture rise three times. Large quantities of sugar and butter tend to retard the growth of the yeast plant. For bread add all the flour at once. Small shapes are

preferable to large ones, as thus more thorough cooking is insured.

Baking of Bread

The baking of bread is not easily disposed of in a few words. Yeast doughs having risen before being put in the oven will bear rather a higher degree of heat at first than other doughs. A more moderate oven is required for loaves than for rolls that the heat may penetrate evenly, but the loaf must remain a sufficient time to raise the center to a degree of heat that will insure the destruction of the yeast. A moderate temperature might allow the dough to continue rising and even to sour from the growth of bacteria when in the oven.

When thoroughly baked, a loaf of bread will seem light and hollow and no steam will come from it to burn the hand as it is turned from the pan.

The usual temperature for baking bread is about 400° F, though a good result may be reached by a more moderate heat continued for a longer time.

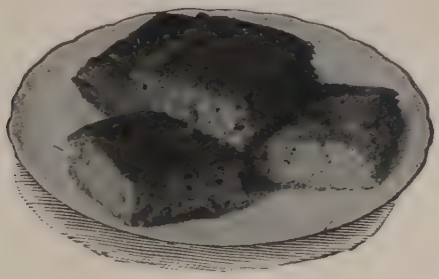
Cooking Soda with Acids

Experiment. Three or four glass tubes or common tumblers are all the apparatus needed for some practical experiments which will make the use of these leavening agents much clearer than does the ordinary cookbook. Dissolve some soda in half a tumbler of water; in another tumbler dissolve some cream of tartar, in a third have a little molasses; in a fourth place some sour milk, and in a fifth some vinegar.

Now put a part of the soda water into each of the other glasses, stir well, and watch the result. Leave

these till later to see how soon the gas escapes and that it cannot be revived. By tasting soda and cream of tartar we shall see that it is desirable to combine them in such proportions that each may neutralize the other. This is done in baking powders.

In another glass dissolve some baking powder, first in cold and then in warm water to show that the gas escapes more rapidly at a high temperature.



CORN BREAD.

These experiments show us why we should sift cream of tartar and soda or baking powder with the flour instead of dissolving it in liquid. The gas which is to make the dough light begins to escape from the soda when it comes in contact with an acid liquid.

Soda and Cream of Tartar

Some baking powder manufacturers try to convince us that their product is so perfect that it is useless for the housekeeper to continue to keep soda and cream of tartar in her store closet. But much as we owe to their perfect methods of grinding and sifting and combining

these substances in the right proportions, there are times when we must use them separately.

Angel cake, for example, requires the addition of cream of tartar to stiffen the egg-white which is its foundation. This aids in holding up the spongy mass until it is made firm by heat. In any case where there is a large proportion of egg-white a slight excess of cream of tartar is desirable.

Molasses and Soda

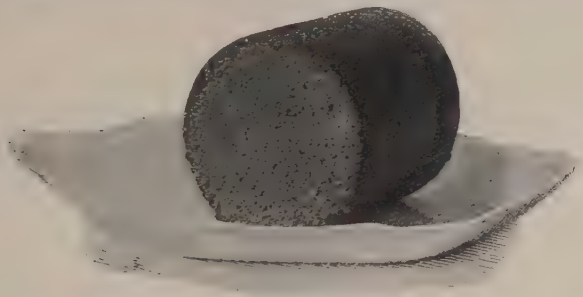
That molasses is acid in spite of its sweetness is evident by testing it with a bit of soda. For this reason soda is added to molasses candy since if it is filled with air bubbles it will be more brittle. The acidity varies in different grades of molasses, and modern methods of manufacture and quick transportation give us a less acid product than that of the past. This explains why many of the recipes of our great-grandmothers called for such large quantities of soda in gingerbread, etc. In such recipes it is usually wise to reduce the quantity of soda and use a small amount of baking powder. Brown bread and all cakes and puddings containing molasses, because of its acidity, are usually more palatable if some soda is used to make them light instead of baking powder only.

Butter contains so much buttermilk that, unless it is washed before using, a bit of soda is essential for all rich cakes and cookies which are to be kept for any length of time.

Sour Milk and Soda

Because of the tendency to use an excess of soda with it, the use of sour milk has been condemned. But

thick, sour milk is not very variable in acidity, and the use of one even teaspoonful of soda with each pint of sour milk is safe. Soda is inexpensive and sour milk is also, while cream of tartar and baking powder are costly. One half level teaspoon of soda is usually enough when one cup of molasses is used, as it is with one cup of sour milk. When it is more convenient to



BOSTON BROWN BREAD.

substitute sweet milk for sour, we retain the soda and add one slightly rounding teaspoonful of cream of tartar.

Strength of Baking Powder

Baking powder contains some starch, but two or three level teaspoonfuls of baking powder are equal in effect to one rounding teaspoonful of cream of tartar and the half level teaspoonful of soda.

Just why some good old recipes recommend dissolving soda in hot water before adding it to the other ingredients, or mixing it with hot molasses, is uncertain. Perhaps the housewives wanted to "see with

their eyes" that action would result. Or the habit might have been the result of the impure quality of the alkaline substance. The "pearl ash," as saleratus was called, was not as finely pulverized as is the soda of today, and may not have been as thoroughly purified from other ash. Hot water would dissolve it quickly, any impurities would settle, and even if some gas escaped enough was left to do the work of puffing up the dough.

Mixing Baking Powder

Such small quaniities relatively of soda, cream of tartar, and baking powder are used in a dough that it has been a question how they should be mixed with the other ingredients to secure the most perfect result. The dough should be light throughout, not here a solid streak, and there large bubbles.

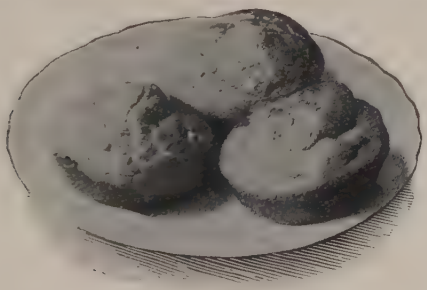
Some teachers of cookery have recommended sifting the one or two teaspoonfuls of baking powder over a cake after it was mixed and beating thoroughly just before pouring into the pan in which it is to be baked. But as soon as the powder comes in contact with the moist surface of the dough some gas will be lost, and moreover, it is doubtful whether two teaspoonfuls of baking powder can be evenly mixed through a quart of cake batter without much beating which does not improve the quality of the cake at that stage and delays the baking.

The accepted plan at present is to sift with the flour the baking powder or cream of tartar and soda or the

soda alone when it is to be used with some sour milk or molasses.

The sooner the process is completed after the acid and soda meet each other the better. Therefore we keep all the materials dry until the last moment, then mix quickly and bake at once.

Similar recipes are found in all cook books, and once the general proportions and the office of each ingre- General Directions



RYE MUFFINS.

dient are learned, it is easy to make many variations. The process of mixing is practically the same in all cases. Prepare the fire and dishes for cooking, before mixing any of the ingredients measure everything, sift all dry materials together, add liquids, mix all thoroughly, and cook immediately.

Changes in the proportions of materials often lead to a change in the manner of mixing them. For example, when a small quantity of shortening is used in batters, it may be melted and beaten in, but if a large Manner of Mixing

proportion is required, it should be rubbed till creamy and blended with the sugar as for cake, or mixed into the flour as in pastry making. For stiff doughs which are to be rolled, it is essential that the fat should be put in cold since even a small quantity, if warm, will tend to make the dough soft and sticky. We grease pans, griddles, etc., because fat prevents adhesion; in the same way fat in a dough keeps the particles separate and makes it break apart readily, so that we call it "short" or "tender." Hence shortening is any form of fat that will accomplish such a result. To give like results, more shortening is required with bread flour high in gluten than with pastry flour low in gluten.

"Shortening"

Eggs in doughs, as in other cases, have the quality of making particles hold together, just the reverse of shortening. Any dough containing much egg will be elastic and spongy, and if cooked too quickly will be tough. Doughs to be made rich with butter, like pound cake, may be saved from heaviness by the use of eggs.

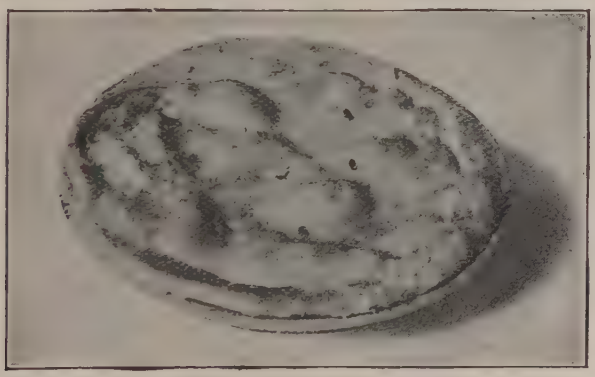
PASTRY AND CAKE

Shortcake and pastry are illustrations of the use of much fat in doughs and the result is brittle and tender. Success in pastry-making depends more upon keeping the ingredients cold and handling the dough deftly than any special formula or order of mixing. When but a small amount of shortening is used, a small quantity of baking powder is helpful; this, of course, is omitted in puff pastry, in which the weights of the

flour and butter are equal, and it is not essential in other cases.

Pastry

Few doughs require a smaller number of ingredients than pastry; flour, salt, shortening, and liquid are the essentials, and air is incorporated in the process of mixing. When the flour and shortening are warm they stick together so that less air is mixed into the dough.



APPLE PIE IN DEEP PLATE.

The process of rolling and folding is a device for catching more air in the dough. This air, when heated, expands and puffs the layers apart. The colder the air mixed in the dough the greater its expansion in baking.

Cake Making

In cake-making a single, well proportioned formula may be made the basis for a great number of varieties. Therefore, it is essential that the fundamental principles be understood, then the variations can be accomplished easily.

MATERIAL AND UTENSILS FOR MAKING CAKE.

Sponge Cake

The principles underlying sponge cake were explained in the section on eggs. The main points in such cakes, which contain no butter and are made light by eggs only, are to mix carefully that sufficient air may be entangled in the dough to make it light, and then to bake slowly but thoroughly.

The shape in which cake is to be baked should decide the proportion of flour to be used. Layer cakes or small cakes require less flour than large loaves. This is probably because the small cake is stiffened more quickly by the heat, while the large mass must be stiffened with flour to hold up the air cells until the heat can penetrate the whole. Variations in cake are easily obtained through changes in flavoring ingredients. To mix chocolate in the cake melt it and mix with the sugar and butter. Such a cake might have a white frosting flavored with vanilla.

Flavoring

A cake flavored with almond may have a few shredded almonds sprinkled over the top just before the cake is put in the oven. Almond paste can be rubbed into the butter and sugar in making cookies; it is rather rich and heavy for a cake. Desiccated cocoanut, chopped nuts, raisins, currants, dates, citron, candied orange and lemon peel, singly or in various combinations, serve to give us many cakes from a single recipe.

Ingredients

The ingredients mentioned for pastry are common to all cakes as well, but further variety is gained by the addition of sweetening and seasoning. Air or gas to make the cake light is obtained by the use of

beaten eggs and of baking powders, etc., as well as by creaming butter and beating the blended ingredients. The shortening for this class of dishes may be lard, dripping, nut oil, cottolene, butter, or cream, each having its own special characteristic. When these are known, combinations and substitutions are possible to adapt a given formula to the available materials.

Sweetening

The range of sweetening is limited to sugar and molasses, but the quantity to be used in a cake should be

SPONGE CAKE STUFFED WITH CREAM.

reduced if a frosting or sweet filling is to be added later.

When we consider the long list of spices and extracts and fruits and nuts available for seasoning the cake, we can see how it is possible to make many varieties of the same cake.

Relative Proportions in Cake

There is a certain relative proportion to be followed in the use of these ingredients which, once learned,

enable us to decide whether a recipe is reliable. In butter cakes there is usually less butter than sugar, and less sugar than flour. When baking powder is used less is required than would be necessary for a dough where there are no eggs. Thus two even teaspoonfuls of baking powder is enough for three cups of flour for a cake in which three or four eggs are use. Some cooks use from one to two teaspoons of baking powder for each cup of flour in all cases, forgetting that the eggs alone would make a cake quite light. When there is an excess of baking powder, the cake is liable to be coarse grained and will dry quickly.

Cottage Pudding

Dutch apple cake and cottage pudding are similar to the common muffin mixture in the proportions of flour, liquid, etc., but are made richer by increasing the quantity of fat and sugar.

Doughnuts

The ordinary doughnut mixture is not unlike a cottage pudding dough, with the addition of flour to make it stiff enough to roll easily. Or it is similar to the quick biscuit dough with the addition of sugar, egg, and spice. Because doughnuts are cooked in fat, less shortening is required than for most stiff doughs.

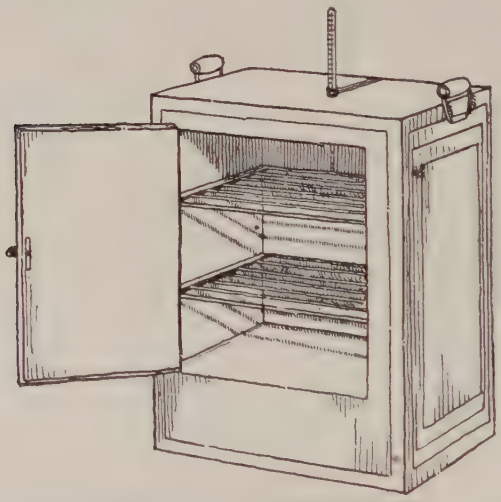
Cookies

Cooky doughs are more like pastry with the addition of sugar, spice, and egg, and the same care should be given to keeping the dough cold in order to roll and cut it without adhering to the board.

COOKING OF DOUGHS

Doughs are steamed, baked in the oven, or on a griddle on top of the stove. Such mixtures of many differ-

ent ingredients are more difficult to cook than the separate substances of which they are composed, though heat affects each ingredient in combination much as it does singly. Sugar carmelizes and this aids in producing a golden brown color in the crust of anything



AN ACCURATE OVEN THERMOMETER.
Punch a hole in a common gas stove oven and insert thermometer, which will register to 600 degrees F, wrapped with asbestos and wire where it passes through the top.

containing it. Since it burns readily, cakes and cookies are more liable to be scorched than unsweetened doughs. Flour browns when exposed to dry heat.

Eggs cook at a low temperature. Butter melts, hence doughs containing much must contain more flour than those that have little or none.

Heat Required

The heat applied should conform to the way in which it affects the principal ingredients in any dough. Those containing many eggs need moderate heat, etc., etc. The size and shape of the article are also to be considered. In general, small thin portions require less time but will bear higher temperature than larger portions as with bread doughs.

Temperature of the Oven

There are various tests for the heat of the oven. Oven thermometers are valuable aids, showing comparative if not actual degree of heat. When a thermometer is inaccessible, a piece of white paper or a teaspoonful of flour if charred from a five minutes' stay in the oven indicate too great heat and other degrees may be gauged accordingly. All parts of an oven are not equally hot and each housekeeper must study her own.

The lower part of a gas oven is very hot because the full force of heat is below; in the wood or coal range one side is usually hotter than the other because of the position of the firebox.

FORM AND FLAVORS

Thus far we have studied the fundamental principles of cooking and have seen that some knowledge of the chemical composition of each food is necessary before we can secure the best result through the application of heat and moisture. But this is only the foundation of the art of cookery.

Variety

The form in which our food is served may attract or repel, and the flavor may make it appetizing or the reverse. We must depend mainly for sustenance upon a few kinds of meat, vegetables, grains, and fruits, and unless variety were secured in some way we should quickly tire of them.

Through the ingenuity of cooks of all times and countries, so many combinations have been devised, by changes in flavor and form, that some of our common foods might appear in different guise every day in the year.

The multiplicity of formulas in our cook-books, even when well classified, are puzzling to the beginner who has not learned to analyze each recipe and thus find the simple processes of which it consists.

"Fancy" Cookery

What is generally termed "fancy" or "high-class" cookery is merely the application of the simple processes to costly foods or a further complicated preparation to foods which have first been cooked as perfectly as possible, according to the principles already outlined.

Creamed Dishes

For example, if we have learned how to make a white sauce and how to cook meats and vegetables, we do not require separate detailed recipes for creamed chicken, creamed oysters, creamed potatoes, creamed cauliflower, or creamed asparagus; we only need to make the sauce a little thinner or thicker to offset the

CREAMED FISH IN RAMEKINS.

dry or watery nature of the article with which it is to be put and to vary the flavor slightly to adapt it to another material.

Variety in Serving

Furthermore, any such creamed meat or vegetable may be served plain, or on toast, or in timbale cases, or combined with buttered crumbs, as a "scallop," or by the addition of stiff egg whites it becomes a "soufflé" when baked. When the sauce is made of double thickness, and combined with the meat or vegetable and chilled, the mass may be shaped into croquettes or cut-

lets which are then coated with egg and crumbs and fried.

Thus any intelligent woman knowing something of the nature of foods and the effect of heat and moisture may to some extent make her own recipes or adapt others to the supplies available at the moment.

Adaptation

No cook-book can be sufficiently expanded to provide for great variation in climate, food materials, and utensils. The cook must constantly adapt to her conditions, she must be observant of the changes of temperature and learn when one food material or flavor may be substituted for another.

Principle of Contrast

If uncertain about the wisest combination of articles of food, whether in a single dish or for the different courses in a menu, it is safe to follow the plan of contrast. Thus the cream soup is served with crisp crackers or croutons, the creamed fish is covered with buttered crumbs and baked till crisp, the croquettes are crisp outside and creamy within.

Another point is to add to any food, substances supplying any of the food principles it lacks. Potatoes are mashed with cream or butter because they lack fat, are blended with egg for croquettes or soufflé because they lack protein. Eggs lack starch, so we serve them on toast or use them in puddings with rice, tapioca, etc.

Made Dishes

Composite preparations of food, often classed as entrees or made dishes, are known by many names derived from different languages, especially from the French.

Here is no place to attempt to define all the terms used on a menu card, but we may group some of these compound dishes under a few general heads and study their characteristics. **Names**

Soups have as their basis either animal or vegetable stock or both combined. Stock is secured by the aid of heat and moisture from portions of meat and vegetables too tough to be used in other ways. Flavor and some nutriment are soaked, cooked and strained out, and this water is the stock which is then further flavored and garnished by the addition of some contrasting substance. Thus a meat stock is usually garnished with grains or shreds of vegetable, and a vegetable stock is often combined with milk and thickened. **Soups**

Stews are thick soups containing larger portions of the meat and vegetables. These are also known as chowders, ragouts, salmis, etc., etc. Sometimes a stew has dumplings steamed over it, sometimes it is covered with a crust of pastry, mashed potatoes, or cooked cereal and baked as a pie. Here again are combined contrasting food principles. **Stews**

Hash is a term that also may include the assortment of foods known as scallops, timbales, etc., since the substance giving a specific name to each of these is minced or chopped fine before it is combined with other materials. Meat and fish are put on toast or mixed with potatoes or bread crumbs or encased in rice or in a pastry shell. The exact proportions of the con- **Hash**

trasting ingredients is of less importance than their proper moistening and flavoring.

The *scallop* owes its name to the shell in which it is often served. *Au gratin* is another name for the same combination of a meat or vegetable with sauce and crumbs. The *croquette* gets its name from its crisp crust, the *timbale* from its thimble-like shape. *Rissoles* and *kromeskies* are kinds of fried meat pies or croquettes in a pastry crust.

Souffles

Souffés have as a foundation fruit or vegetable pulp or minced meat in a sauce and are puffed up by the introduction of stiffly beaten egg whites. The name is sometimes given to cold dishes where a similar effect is gained by whipped cream.

Salads

Salads may consist of cold cooked meats, fish, etc., vegetables cooked or raw, fruits and nuts. Almost any food may be served in a salad, singly or in combination. The distinctive feature of a salad is the dressing of fat, oil, butter, or thick cream, which is variously flavored.

Left Overs

Many of the most satisfactory of these made dishes doubtless had their origin in an effort to use left-overs.

Milk surplus may be used in many ways. Skimmed milk answers as well as full milk for soups and doughs when fat is also used. Even if otherwise likely to curdle in heating, the addition of a little cooking soda makes it possible to scald milk, and then it may be used for custards, puddings, etc. Sour milk is available for

doughs and cheese, and cream may be substituted for butter and milk in simpler cakes and cookies.

Eggs left at the table in a soft-boiled condition may be cooked again until hard and then combined with sauces and served on toast or used as a garnish in soups or salads.

Meat left-overs should be carefully sorted.

Meat Left Overs

The obloquy heaped upon hashes is due to carelessness. All uneatable portions,—bone, skin, and gristle, should be removed, but may yield a little stock if put in cold water. The clear lean may have about one-fourth as much fat with it if it is to be used in the combination with potatoes, bread or cereal. There may be two grades of the lean, one cut in pieces of uniform shape an inch or more across, to be served in a sauce or moulded in a jelly; the other to be chopped fine for hashes, croquettes, etc.

Vegetables. Cooked vegetables spoil quickly but often may serve as soup, or a scallop, or a salad for a second meal.

Fruit Combinations

Fruits. It seems practically impossible to put together several kinds of fruit without good results. Combinations of left-over fruits, raw or cooked, will serve as the basis of a gelatine dessert made like the jelly described elsewhere, or may be frozen alone, or combined with cream, or thickened for a pudding sauce, or diluted with water for a fruit punch. Add sugar as desired.

Bread. No scrap of bread of any kind need be lost. Brown bread and muffins of different kinds are sometimes wasted when they might be steamed, or toasted and served in cream sauce, or made into puddings like a baked Indian pudding. Slices of stale raised bread, dried, gives us croutons, cut in cubes, or crumbs white and brown, coarse and fine, to use for scalloped dishes, stuffing for fish and poultry, and for many kinds of sweet puddings.

Attractive Form

The use of gelatine is an instance of our endeavor to make foods attractive in form. It has doubtful food value and no agreeable flavor, but it gives solidity to fruit juices, or in aspic jelly to soup stock, and in such jellies we may mould fruits for dessert, or meat and vegetables for salad.

Garnish

Garnish is often desirable to make foods more appetizing, but it is a question whether this purpose is served by the addition of unedible materials which must be laid one side before the food itself is accessible.

The truest art does not waste effort on useless things.

Shapes

The form of foods is further varied by utensils producing different shapes, the meat choppers with adjustable knives for particles of different sizes, the fancy knives for making thin slices or balls of vegetables and fruits, the muffin pans, waffle iron, the timbale iron, the many cutters and moulds for puddings, etc. The tendency of the present day is plainly towards small portions for individual service, and here again a

new recipe is not required, only the necessary changes in time of cooking which would result when a mass was divided into several portions. Moulds in which a food is to be cooked should be greased, but rinsed with cold water when the food is only to be cooled in them.

Scales and measures are lacking in many kitchens and accurate work is impossible without them. The

Weighing

SALMON LOAF.

average kitchen need not be furnished with many special utensils, but there should be a full supply of "general purpose" articles of the best grade of material and finish.

The utensils should be adapted to the size of the family and to the physical ability of those who are to use them. The saving of human life and energy is more to be considered than the durability of implements.

Utensils

FLAVOR

The art of cooking shows us many ways of developing the appetizing flavor of foods.

Preparation

First, by the removal of whatever might produce bad flavors, such portions as skin and tainted bits of meat, decayed parts of vegetables, and over brown portions of bread and cake.

Right Heat

Second, by the right application of heat and moisture to bring out the natural flavors in each food. The steeping of tea instead of boiling, the browning of the coffee berry and cocoa bean before they are ground, the flavor developed by long cooking in cases like the baking of beans and steaming of puddings and brown bread. Sometimes a portion of the nutritive value is sacrificed to flavor, as in the browning of the outer surface of the steak or roast.

Third, by the use of many additional flavoring materials to intensify natural flavors to supply deficiencies and to produce variety.

Common Salt

Salt is useful as a preservative, seems to supply a need in the human system and therefore is an agreeable addition, but it also serves to bring out natural flavors. As an illustration of this power, taste of a meat or chicken broth that is unsalted, and again after salting, when the flavor of the meat will be much more apparent. For this purpose salt is often eaten with fruits, is added in minute quantities to lemon and other jellies made with gelatine, to custards, ice creams, and often even to coffee.

Lemon juice is also an aid in extending other flavor and is acceptable with many foods, especially fish.

Common Flavoring Material

Salt, pepper, lemon, and onion are the extent of the flavors used in some households, and food need not be insipid if no others are tried, but it is wiser to make occasional use of the long list of condiments and spices.

Condiments and Spices

The distinction as usually made is that the condiments pepper, mustard, etc., are used with meats, while spices, cloves, ginger, cinnamon, nutmeg, etc., are associated with fruits and sweets, but this classification has exceptions. Spices are neglected nowadays and it often seems as if people hardly were acquainted with any other flavor for dessert dishes than vanilla. The list of flavoring herbs is a long one, running through sage, thyme, majoram, summer savory, bay leaves, tarragon and parsley, which are used dry or fresh, to the green mint, cress, and salad plants which are condimental rather than nutritive.

There are many compound flavors which every housekeeper should keep in her store closet, and use in her cooking instead of supplying a single perennial catsup on the table, such are curry, tabasco, tarragon vinegar, mushroom catsup, poultry seasoning, etc.

Onion, celery, cheese, chocolate, coffee, meat extracts, each may have an important place in our list of flavors.

Sugar as Flavoring

Sugar is an important food and also must be looked upon as a flavor, since it will often bring an insipid vegetable up to its normal condition.

Blended Flavors

French cooking excels in that blending of flavors which produces an agreeable effect, though no one is apparent.

Adding Flavoring

The best results are usually reached when the flavoring is combined with the food in the process of cooking, but there are right and wrong ways of doing this. If salt is put on the cut surface of a roast, juice will be drawn out, but if sprinkled over the fat will gradually flavor all. Whole herbs and spices, tied in a bit of cheese cloth may be left to cook in a soup stock or brown gravy until the desired flavor is attained and then withdrawn, leaving the stock clear. Ground spices would give a cloudy effect.

Reasons for the Use of Flavoring

The use of flavors is economic, for thus inexpensive foods are varied and made palatable. It is a part of the art of cooking, since nowhere are greater skill and intelligence required than in the distribution of these elusive yet powerful substances, and by discrimination in the use of condiments and spices our foods may be made more healthful.

FOOD FOR THE DAY

In the preceding pages the most important foods, their composition and preparation for the table have been considered. Our study would be incomplete without some reference to their best combination for the daily meals that they may appeal to the palate and promote health without exceeding the bounds of moderate incomes.

Buying
Cooking
Serving

There are three important divisions in the preparation of food for a family, wise buying, good cooking, and careful serving. When buying foods the housekeeper should know the sum available for feeding each person for the day or week, she must note the season of each food, and also adapt her choice to the climate and weather. She must remember the individual needs of each member of the household, depending upon age, health, and occupation.

Art of
Cookery

The art of cookery finds its field between the choice of food and the serving of the cooked dishes at the table. As with other arts perfection can come only through constant practice in manipulation, and from continual adaptation of conditions to the desired end. No formulas for combinations of foods can be devised so complete that continuous care is not required in every step of the process.

Cost of Food

Few housekeepers have the time or take the trouble to keep their accounts in such a way as to know how much it costs to feed each person in their charge for a day, week, or month; fewer still know anything of the relative proportion of protein, fat, and carbohydrate which is placed on the family table week by week.

When purchasing clothing we take note of its wearing qualities and the ability to keep us warm, but we seldom apply the same reasoning to our foods, although it is quite as necessary.

Some one has estimated that in the average household one-tenth of the sum spent for food will go for flour, a tenth for butter, another for sugar, another for milk, one-fifth for meat, one-fifth for fruit and vegetables, and the remaining fifth for sundries.

"Constants"

There are certain articles of which equal quantities will be used each week or month, and by an examination of previous bills it is easy to estimate the amount required for a given period. Many of these "constants" like butter, sugar, and flour, can be bought in quantities sufficient for a month, then the housekeeper knows how to apportion her money for the variable supplies.

It is not necessary for the housekeeper to attempt to estimate the proportion of food principles in every dish she serves, but once a month or a quarter, if her accounts are well kept, she can see how nearly she ap-

proaches such daily estimate as the one below for each member of her family:

A DAY'S RATION

	Ounces.
Meat and fish	12 to 16
One egg	2
Butter	1 to 2
Milk, 1 gill to 1 pt.	4 to 16
Sugar	2 to 3
Dry fruits	1
Legumes	1
Fresh vegetables and fruits	6 to 8
Potatoes	8 to 12
Flour and grains	12 to 16

Multiply this by thirty and we have a fair allowance for one person for one month. Multiply this by the number of persons in the family, or, to be more accurate, by the fractional parts of a man's rations, usually allowed for women and children, and we have an ample supply for one month for the family.

If the larger quantity of potatoes has been used the smaller amount of flour would have been ample, while if eggs were cheap and two or more consumed by each person daily there should be a corresponding reduction in the amount of meat and fish.

Refuse and Waste

Of the amount purchased there will be not far from 10 per cent refuse and waste. Refuse in the form of bones, skin, and parings, waste of what is left on individual plates and odd bits that are spoiled and are

thrown away. Much fat also is thrown away, but it should be remembered that fat is worth more than twice as much as the carbohydrates in keeping the body warm.

A Day's Alowance

Twenty-five cents a head a day is a fair allowance for an abundance and variety of wholesome, satisfying food. Life may be sustained on half that amount, while fifty cents daily cannot nourish more completely, but may provide luxuries and foods out of season.

Cost of Labor

The actual cost of table board appears, from studies made under different conditions, to be about equally divided between the raw material and the labor required for the preparation and service. It may be cheaper to pay a little more for a prepared food than to use one's own strength or pay for service to get ready a less expensive article.

The woman who has time and strength and no other way to earn should choose the cheaper grade of food. Cheapness does not always indicate meanness, it may mean an abundant supply or less human labor in preparation.

Prepared Food

There is a growing tendency toward the fuller preparation of food outside the home, but there is the more need that the housekeeper should be familiar with processes of manufacture that she may know when she is well served.

Buying

The housekeeper who never goes to grocery and market and does not study the market reports in the

papers is rarely an economical buyer. She is liable to go on in the same old routine instead of varying her menus with the little surprises that may be found by visiting the markets. There are bargains to be had in foods as well as in clothing, when the market is overstocked, or some odd lot is left over. Cuts of meat cannot be made to order and the first choice falls to the early visitor to the market.

Where one woman must take entire care of a family, she must plan carefully if she would have a well balanced household. Elaborate cooking and meals of many courses are out of the question even if they were desirable. Meals should be planned several days in advance and the buying done accordingly, though such plans will be much modified in the performance. **Planning**

A reserve store of canned foods, etc., is a great aid in the emergencies that arise in all households.

By wise use of outside supplies and by making one's head do more work and hands and feet less, the food for a family may be provided without exhausting the energy of the housekeeper. **System**

The actual cooking necessary for a family through a day may be done in a shorter period than is usually allotted to it if the work is planned wisely. The detail of arrangement depends upon the kind of fuel used, and whether the chief meal is served at noon or night.

Breakfast

The breakfast should be a simple meal—fruit, raw or cooked, cereal or warm muffins, (seldom both at the same meal), and eggs, bacon, creamed salt fish or some cold meat. When the meat is cold the bread is warm, while with bacon or omelet toast may be served.

Some one must be in the kitchen for some time to prepare and serve even a simple breakfast, especially if there are tardy members of the family. With the same supply of fuel required for the muffins, it is not difficult for a woman of average ability to bake a cake or pudding which will then be ready for the noon or the night meal. Or at this time the vegetables may be cleaned, fruit picked over and little details attended to which save much time later.

Dinner

Noon dinners usually are considered easier for housekeeper and cook, since the work can all be done by daylight and the hours of work if not actually less are not so extended through the day. When supplies are ordered early and delivered promptly, much energy and worry is saved. At least half the time the soup may be derived from previous supplies, and be prepared in advance.

One kind of meat or fish, potatoes or rice and a single other vegetable or salad are enough for all ordinary occasions. Fruit or a dessert prepared earlier in the day completes a meal sufficient for all needs of the human body if the articles have been chosen wisely to supplement each other.

Supper

For a noon luncheon or night supper there are many variations of the soufflés, hashes and scallops already described. One of these with bread and butter, tea or cocoa, fruit and a simple sweet will provide all that is essential.

To prepare meals for a family year in and out is not an easy task. The housekeeper must remember not only the cost and nutritive value of the foods but the whims and notions of her family. The ability of the human being to talk makes him much harder to feed than the animals who must accept the balanced ration bestowed upon them.

Planning Menus

A few points to be observed in planning menus are these: avoid routine, introduce novelties, cheap or expensive, in attractive form, but say little of nutritive value or cost. Do not allow the same meat or fish to appear too many meals in succession. Let something else intervene. When the meat course is substantial let the dessert be light and make the dessert especially nutritious when the meat course is insufficient. Let there be variety on the table through the week or month but have few dishes at each meal.

In Conclusion

The fundamental processes of cookery are not many and the essential points have been outlined in these pages. An intelligent woman can adapt the recipes in any reliable cook-book to her own conditions after she knows something of the composition of foods and the way each is affected by heat and moisture.

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Boston Cook Book ($2.00). Mary J. Lincoln.
Catering for Two ($1.25). Alice J. James.
Century Cook Book ($2.00). Mary Roland.
Home Science Cook Book ($1.00). Anna Barrows and Mary J. Lincoln.
Kitchen Companion ($2.50). Maria Parloa.
Practical Cooking and Serving ($2.00). Janet M. Hill.
Practical Sanitary and Economic Cooking ($0.40). M. H. Abel.
Young Housekeeper ($1.00). Maria Parloa.
Rorer's (Mrs.) New Cook Book ($2.00). Mrs. S. T. Rorer.
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Luncheons ($1.40). Mary Roland.

Note.—These books may be borrowed by *Members*. Any one may purchase them through the School by sending price.

GOVERNMENT BULLETINS

Free, of the Department of Agriculture, Washington, D. C.
34. Meats: Composition and Cooking—Charles D. Woods.
85. Fish as Food—C. F. Langworthy, Ph.D.
93. Sugar as Food—Mary Hinman Abel.
121. Beans, Peas and other Legumes as Food—M. H. Abel.
128. Eggs and their uses as Foods—C. F. Langworthy Ph.D
182. Poultry as Food—Helen W. Atwater.
183. Meat on the Farm—Andrew Boss.
203. Canned Fruits, Preserves and Jellies—Parloa
249. Cereal Breakfast Foods—Woods and Snyder.
256. Preparation of Vegetables for the Table—Parloa.
263. Use of Milk as Food—R. S. Milner.
293. Use of Fruits as Food—C. F. Langworthy.
295. Potato and other Root Crops as Food—Langworthy
298. Food Value of Corn and Corn Products.
332. Nuts and their use as Food—M. E. Jaffa.
359. Canning Vegetables in the Home—J. F. Breazeale.
375. Care of Food in the Home—Mary Hinman Abel.
389. Bread and Bread Making—Helen W. Atwater.
391. Economical use of Meats in the Home—Hunt

PRINCIPLES OF COOKERY

PART III.

Read Carefully. Place your name and address on the first sheet of the test. Use a light grade of paper and write on one side of the sheet only. *Do not copy answers from the lesson paper.* Use your own words, so that the instructor may know that you understand the subject. Read the lesson paper a number of times before attempting to answer the questions.

1. Mention and describe three methods of making doughs light.
2. What are the advantages in the use of baking powder? When should baking soda and cream of tartar be used separately?
3. Describe some mixture where more than one means of making it light is used.
4. How does the bread obtainable outside your home compare with what you can produce there as to cost, including time and fuel, substance, and palatability?
5. Experiment, if you can, under your own conditions and report of the effect of too rapid and too slow baking on different types of dough.
6. Rearrange this recipe for a simple cake in proper proportions and order of mixing: ½ egg, 2 teaspoonfuls butter, 2 c. milk, 1 c. flavoring, 1 teasp. flour, 3 c. baking powder, 1 teasp. sugar

7. Give examples wherein the form and manner of serving may add to the attractiveness of food and not require too much time.
8. How does bread flour differ from pastry flour? How does this affect its use in doughs?
9. Give the general proportion of flour and liquid in (1) soft doughs, (2) a batter, (3) muffin mixtures, (4) pastry or cookies.
10. Why does shortening make doughs flaky?
11. Give the one method of making bread. What conditions will hasten the process; what will retard the process?
12. Successful pastry—how made?
13. What varieties of cake are there and what ar the general proportion of the ingredients? Give some of the reasons why a cake "falls?" What makes cake dry and coarse in texture?
14. Discuss the use and abuse of "fancy cookery."
15. What is meant by contrast in foods? Give examples.
16. What can you say of flavoring?
17. How may "left-overs" of meat—of vegetables—of bread, be used?
18. On what principle should menus be planned?
19. Give the menus for the meals served in your household during one week and suggest how they might be improved without additional labor or expense.

20. With what cook book are most familiar? What are its good points and what are its deficiencies?

21. Have you had any failures in cookery which you cannot understand and which you would like to have explained?

22. What new facts and principles have you learned from this series of lessons?

NOTE.—After completing the test, sign your full name.

PRINCIPLES OF COOKING

PART IV

SUPPLEMENT

ELECTRIC KITCHEN EQUIPMENT

"Aluminoid"-Covered Kitchen Table and Children's Table; General Electric Co. Cooking Outfit (Cost $95.00); Hoosier Kitchen Cabinet; Bohn Syphon Refrigerator. (Photograph furnished by a member of the A. S. H. E.)

SUPPLEMENT

PRINCIPLES OF COOKERY IN APPLICATION TO DAILY LIFE

By Anna Barrows

Director, Chautauqua School of Cookery; Lecturer, Teachers' College, Columbia University, and Simmons College.

The conditions of life in the households represented by the pupils of this school vary greatly with locality and climate, and, taken together, would give a fine composite picture of the average American home.

While reading the hundreds of papers which have passed through my hands since the School opened, nothing has impressed me more than the variety of conditions to which any woman in this country must be ready to adjust herself at short notice. Much human energy might be set free for other purposes, and much money saved, if men and women gave closer study to some of these every-day questions.

Emerson has said truly: "We must learn the homely laws of fire and water; we must feed, wash, plant, build. These are the ends of necessity, and first in the order of nature. Poverty, frost, famine, disease, debt, are the beadles and guardsmen that hold us to common sense."

COMPARATIVE VALUE OF FUELS

Every householder and housekeeper should have more definite knowledge regarding the amount of heat available from a given bulk of each of the stand-

ard fuels. One cord of wood is approximately equal to one-half ton of coal; 1,000 cubic feet of coal-gas is equal to 50 or 60 pounds of coal, or about four and one-half gallons of oil or gasoline. The time required to keep stove and fire in good condition must be counted with the cost of the fuel.

In this connection, facts reported in some of the test papers received are interesting.

From a southern plantation, wood is reported as costing only the labor of preparation for the stove, and that only sixty cents a cord. In another locality, one sixteenth of a cord of wood is used daily at a cost of twelve cents, or about two dollars a cord. Elsewhere, a housekeeper finds wood at five dollars a cord the cheapest fuel within her reach, and estimates her daily supply to cost ten cents, or about one fiftieth of a cord. Another burns a cord of wood each week for cooking only.

An English pupil writes: "The range to which I am most accustomed is the almost universal farmhouse open fireplace and Glendenning oven, used in Cumberland and Westmoreland. The oven is heated by the hot air from the fire by a passage at the back of the fireplace, with only one damper for oven. At the opposite side there is nearly always what is called here a 'set-pot' for heating water. The heat of my oven is greatest at the bottom, on account of the hot air being underneath. What is not cooked in the oven is done over the open fire."

COAL

The price of coal varies according to quality and distance from the mines, and may cost from three to twelve dollars a ton. A hodful or scuttle of coal may weigh from fifteen to thirty pounds, but after weighing the contents of an average hod, any housekeeper may estimate readily the amount used daily, or for different purposes.

One woman writes that she can do her day's work with a single hodful of coal, making a ton last nearly three months, while a maid in her kitchen usually disposes of a ton a month. Another housekeeper runs a fire day and night on half a ton a month, while in a colder region three hods daily is the usual winter allowance.

GAS

Gas is available in comparatively few sections of the country outside of the large cities, but wherever it is used, housekeepers soon learn to plan their cookery to save fuel. This usually results in economy of time, so that fewer hours are spent in the kitchen, though all the necessary work is as well done as before.

A thousand feet of gas a week is a generous allowance for kitchen use in an average family. According to one report, gas at $1.50 a thousand feet has proved cheaper than coal at $5.00 a ton.

One cannot use a gas range in the same fashion as the wood or coal stove, but must adapt herself to its

plan and the nature of the fuel. A steam cooker makes it possible to cook enough food for two days over one burner at one time. Today's dinner, a cereal for tomorrow's breakfast, some cup custards for supper, a stuffed fowl to be browned over in the oven for tomorrow's dinner, all may be cooking at once.

Then, with the ovens as commonly arranged, we may broil or roast beneath the flame which is heating the other oven to bake potatoes, bread or cake.

One pupil reports that she boils potatoes in the lower part of the double boiler while cooking cereal for the next day, and above that sets a basin of milk to heat for a pudding or sauce or soup. By such forethought the expense of gas is no greater than any other fuel, and the labor of housework is much reduced.

ALCOHOL

The removal of the tax on fuel alcohol, January, 1907, may mean much to the housekeeper as well as to the manufacturer. Every one who has used a chafing dish or alcohol lamp has wished that alcohol was as cheap as kerosene. Under the new law it may reach that point.

Since it may be made of many coarse and inferior vegetable products now unused, there need be no lack of this fuel, which is practically without odor or smoke.

Thus the housekeeper must be ready to adapt her-

self to another change in fuels and apparatus for its use.

With the alcohol lamp and the hay-box much of the discomfort and dirt now associated with kitchen processes will be banished, never to return, and the kitchen itself well may be dignified with the name of "laboratory."

KEROSENE

The small oil and gasoline stoves are not used as much as they deserve. With intelligent care and high-grade oil, a well-made oil stove is safe. Fire in any form is not a plaything.

Every household without gas or electricity should be supplied with a good three-burner lamp stove and small oven to fit it. These will cost about $3.00. If this lamp is given the same care that is given lamps for evening use, results will be satisfactory. But one must not expect a small stove to work as rapidly or accomplish as much as a larger one. Have the lamp full of oil to do good work. Do not let it burn many hours in succession, but give it a chance to cool off. Keep the wicks even and clean, and have new ones when they become discolored, or too short to reach the bottom of the lamp.

Oil stoves are liable to smoke if they stand in a draft, and therefore should be protected. Choose utensils to fit the stove and oven, and never fill them so full that there is danger of boiling over into the lamp. Since the heat is greatest in the lower part of

the oven, cook on the upper shelf as much as possible, or exchange when possible. Asbestos mats may be used on the lower shelves. With two three-burner lamp stoves, and an oven to fit one, it has been easy several times, in my own experience, to do all the cooking for a family of six or eight persons.

FIRELESS COOKERS

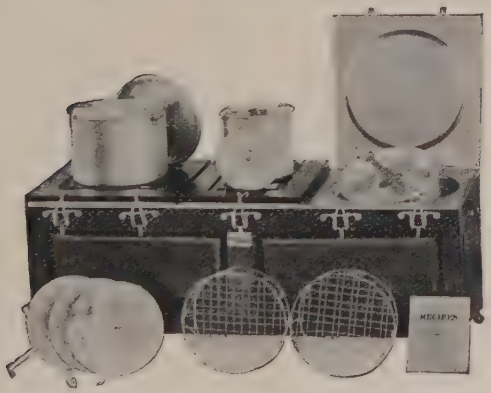
The Norwegian Cooking Box or Fireless Cook Stove is described and illustrated on pages 12-13. This device has been exploited so much of late that it deserves further description.

The new interest in this method of cooking is probably due to the experiments made in 1905, under the direction of the Commissary-General of the War Department, and these were the result of a report from United States Consular Clerk, George H. Murphy, of Frankfort, Germany. Below is a condensation of Mr. Murphy's report, as it appeared in Daily Consular Reports in April, 1905.

"In an address to an audience of working people, Mrs. Back, wife of the director of the industrial school at Frankfort, brought to the attention of her hearers, the hay-box or fireless stove.

"Every housewife knows that a pot of coffee can be kept hot for some time, without fire, simply by wrapping it in a dry towel to hinder escape of heat. The Norwegian "automatic kitchen" attracted attention at the Paris exposition of 1867 but failed to come into general use. Now in Berlin, Munich, and

CYLINDER TYPE FIRELESS COOKER



BENCH TYPE FIRELESS COOKER

The "Caloric," Aluminoid Lined with Aluminum Utensils. The aluminum utensils with clamped covers can be purchased separately for home-made cookers.

other cities popular lecturers are showing the practical value of this method of cooking.

"Mrs Back stated that she had used the hay-box for thirteen years, thus greatly reducing the cares of housekeeping. At first she used the box merely to keep finished food warm. Discovering that the process of cooking continued, she experimented and found that she could finish, in the box, all boiled and roasted meats, sauces, fish, soup, vegetables, fruits, puddings, etc.

"The box cannot be used for articles whose chief attraction lies in the crispness resulting from rapid cooking on a hot fire, but the rest of the meal may be ready and hot in the box. Patience will secure needed experience, and remove all doubts. In general, two or three minutes actual boiling on the fire is sufficient for vegetables, while roasted meat requires twenty to thirty minutes. Most articles should remain tightly closed in the box for two or three hours, and may be left to keep hot for ten or twelve hours.

"Dried legumes, fruit, etc., should be well soaked in cold water, allowed to boil two to five minutes and left for two hours in the box. Soft vegetables should be merely brought to a boil and then placed for an hour or two in the box. Soups are improved by being allowed to develop for two or three hours in the box.

"Covers of pots should not be lifted when they

are being transferred. The object is to retain the heat as long as possible when it has once been developed. Too much water is better than too little.

"A home-made hay-box will usually be found cheaper and more practical than those with immovable felt and upholstery. Almost any box will do, which has a tight cover. The wood should not be too thin, and there should be no knot-holes or cracks. Old trunks and valises may sometimes be used in this way.

"The box should be loosely filled with shavings, paper or hay, the last being probably most satisfactory. The hay should be renewed every two or three weeks. Nests are made for the pots and the hay packed tightly under and around them. Any kind of pots can be used, although, of course, earthen ones hold the heat best. The tighter the tops fit, the better, but if the food is to be used within six or eight hours, they need not be hermetically closed. When the pots have been placed in the box carefully, without lifting the lids, they should be covered with a pillow and the lid at once securely closed.

"When not in use, the box should always be left open and the hay loosened, the pillow being hung in the air to dry thoroughly.

"The chief advantages of the hay-box may be summarized as follows:

"The cost of fuel can be reduced four-fifths or even nine-tenths.

"The pots are not made difficult to wash; they are not blackened, and they will last for an almost indefinite period of time.

"The food is better cooked, more tasty, more nutritious and more digestible.

"Kitchen odors are obviated.

"Time and labor are saved.

"There is no need of stirring, no fear of scorching or burning.

"The cares of the housewife are lessened, and her health and happiness are protected.

"The kitchen need not be in disorder half of the day.

"Warm water can always be had when there is illness in the house and during the summer when fires are not kept up.

"Where workmen's families live crowded in one or two rooms, the additional suffering caused by kitchen heat is obviated by the hay-box, for the preliminary cooking can all be done in the cool of the morning.

"At picnics the appetites of young people are only half satisfied by sandwiches and other cold food. The hay-box can furnish a hot meal anywhere at any time.

"Similarly, men and women working in the fields, or having night employment, can take with them hot coffee, soup or an entire meal, thus avoiding the necessity of returning home at a fixed hour or having it brought to them by another member of the family.

"When different employments make it necessary for the various members of a family to take their meals at different hours, this can be arranged without a multiplication of work with the assistance of the hay-box."

This consular report covered the ground so fully that any intelligent woman can make it the basis of experiments adapted to her own surroundings.

A small trunk measuring 18x22x24 inches, an agate-ware kettle with close tin cover, made to order to fit in, or merely rest on the kettle, were the appliances which served me satisfactorily this summer.

It was not easy to secure hay, so we looked about for a similar non-conducting substance, and found some boxes of excelsior and sawdust — not quite enough of either, so they were combined and put in bags and sewed up closely enough to prevent clutter. The most of the bags were of denim, but some thin cotton bags, in which five and ten pounds of sugar had come, were filled, and did good service in filling chinks.

To test the heat-retaining capacity of this outfit, two gallons of water was raised to the boiling point in the kettle. Closely covered, it was placed on one of the thicker cushions in the trunk and the others fitted in closely around and over the kettle. A blanket and some newspapers were spread over all, and the trunk locked. Twenty-four hours later the water was hot enough for dish-washing or bathing.

The statements made in the above report were fully verified by my own experience. This method of cooking is especially adapted to any article requiring long, gentle heat, such as the making of soup-stocks and broths and rendering tough meats tender. With very tough fowls, when the water cools down below 150-160° F., the whole may again be raised to the boiling point and started again in the hay-box.

It must not be expected to do everything, but every housekeeper who must depend upon a gas or kerosene stove should arrange a fireless cooker for economy of fuel and to increase her own comfort.

Many an American housewife uses both coal and gas ranges in her winter home, and in the summer cottage must depend upon wood and kerosene stoves. Probably during the year she also uses a chafing-dish occasionally, and that may derive its heat from alcohol or electricity. Wherever a house is supplied with electric lights there should be at least one electrical cooking appliance. Some excellent ones are already on the market, and the next generation, doubtless, will use this force in housekeeping as freely as we use gas.

Each of these methods of securing heat for cooking may be the best under certain conditions and have disadvantages under others. The housekeeper needs to be keen in judgment and quick to see in order to adapt her formulas of cookery successfully in turn to wood, coal, gas, kerosene, gasoline, alcohol or

electricity. She must know how to tell when a thing is "done," and not trust wholly to the number of minutes prescribed in a recipe.

Women who are called upon to make such rapid transitions become adaptable, inventive, and are less "set in their ways" in other directions. The study of processes of cookery may thus become a broadening influence and means of general education.

CO-OPERATIVE COOKING

But there are certain household traditions which hold many intelligent women in a firm grasp, and these traditions may be traced to the generations behind us, when no money value was placed upon woman's labor. It does not yet seem easy for women to count fairly the cost of foods cooked under their own roof. Until this can be done there is small chance for co-operative industries, which might relieve the pressure of home cares where house-workers are not readily secured.

Few families to-day find it wise to make butter for themselves, and many would do well to buy bread, also. When there is a demand for high-grade bread made outside the home, it will be supplied, as has been the case here with other commodities, and with bread in other countries. There are many small towns to-day to which bread is sent from first-class bakeries 100 to 200 miles away.

With stronger laws, better enforced for the cleanliness and purity of food products; with greate-

HEAT CONSERVER

Apparatus used in an attempt to deliver hot meals at a distance.

ONE WAY TO COMBINE FRUITS

intelligence on the part of the consumer, and greater skill on the part of the producer, there is no reason why we should not in the future be able to secure wholesome prepared foods of all grades at fair prices outside the home, rather than attempt to prepare everything under the home roof.

The isolated home must still be its own factory, and its director must be a Jack of all Trades. Such households should be supplied with all helps to make labor easy, but even then, much hard labor is necessary. Only where large quantities of any product are to be prepared does it pay to have all manner of machines and cunning devices to produce the most perfect results.

KITCHEN FURNISHINGS

Where many people are to be fed, a few good tools like a bread-mixer (See p. 105), meat-chopper, etc., are often more helpful than another pair of hands, unless they are especially efficient ones.

One pupil has asked for a list of necessary kitchen furnishings. A good list is given in *Household Management*, page 105. Here is another designed for beginners in housekeeping, or for small families living in city flats, where there is no room to store superfluous utensils. The stove and refrigerator are usually supplied with such apartments.

For light housekeeping, where a chafing-dish or small oil or gas stove is the only means for cooking, still fewer utensils would suffice. With the addition

FANCY MOULDS

MOULDS FROM OLD TIN CANS

Good shapes for puddings

of a few fancy molds, all the foods illustrated in this book could be prepared by the utensils here mentioned. On page 101 some of the most useful are shown.

When selecting any utensil, be sure that it is of good quality, with no imperfections that will interfere with keeping it perfectly clean.

KITCHEN FURNISHINGS.

High stool	$1.50	French knife	.50
Scales	1.00	Paring knives (two)	.30
Fibre pail	.50	Spatula	.30
Dish pan	.50	Cork screw	.25
Soap shaker	.10	Can opener	.50
Dish mop	.10	Measure . cups, glass and tin	.20
Vegetable brush	.10	Wire egg beater	.10
Tea kettle	1.00	Dover egg beater	.10
Pastry board	.40	Fine strainer	.05
Rolling pin	.10	Coarse strainer	.10
Chopping bowl and knife	.50	Colander	.20
Bean pot	.30	Flour sieve	.20
Lemon squeezer(glass)	.10	Wire potato masher	.10
Tea pot	.25	Grater	.10
Coffee pot	.50	Wooden spoons (two)	.20
Muffin pan,agate ware	.50	Tablespoons (six)	.20
Quart measure	.35	Teaspoons (six)	.10
Pitcher	.50	Long fork	.10
Stew kettle and cover.	1.00	Cutters (two)	.20
Roasting pan	.50	Omelet pan	.25
Sauce pans (three)	.75	Loaf pans (three)	.60
Bowls (two)	.50	Cake pans (three)	.30
Double boiler	.75	Cake pans (three)	.30
Two quart pans (two)	.50	Scotch bowl	.50
Deep plates, to fit pan as covers (two)	.50	Glass jars (one dozen).	1.00
Cups for moulds (six)	.75	Total	$20.00

THE HOUSEKEEPER'S LIBRARY

Quite as important as helpful utensils to the housekeeper are the right kind of books.

When we remember that cooking schools have been established for a generation in all our large cities, and that the lessons given in such schools have in several places been put in book form, and when we see the lists of cook-books sent out by publishers, we might suppose that every housekeeper in America would be the possessor of several reliable cook-books. But even the intelligent women taking this course are rarely well supplied.

One pupil honestly states the matter thus:

"My failures have been many, owing partly to my lack of a cook-book. I have overcooked custards, and undercooked corn starch. I have stirred and beaten all the gas out of pancakes, and wondered why they did not rise, etc., etc."

Many women everywhere are content to depend upon cook-books issued by patent medicine venders, and upon newspaper clippings liable to typographical errors. Such things may afford helpful suggestions, but much food-material has been wasted by blind following of careless printers, and writers who have little knowledge of the art and science of cookery.

Enterprising business men realize that they must read their trade journals to keep abreast of the tide of competition. Many a woman spends more than a dollar a year for tissue paper patterns for clothing,

who would hesitate to buy a cook-book once in five years, or to subscribe for a reliable household magazine.

There has been little cash recompense for the housekeeper, however much she studied her trade, but now we are beginning to realize that personal health and family comfort are above price; that they depend chiefly on the air we breathe, the water we drink, and the food we eat.

On page 140 of this hand-book, there is given a list of reliable books relating to food and cookery, the whole costing about $20. The average American housekeeper, especially if she does her own housework, should *own* at least half of these books. While she may not find it feasible to spend more than a dollar a year in this way, still she may be sure that ten dollars spent in the purchase of helpful books would save more than that amount, in a single year, in her bills for food materials.

Any one near a public library has the opportunity to read such books, and thus discover which are the ones she wishes to own. If the library is not already supplied in this direction, send in requests that certain books be purchased. (Any of the books will be loaned to members by the School).

The study of this hand-book lays the foundations in the fewest words possible for the fundamental processes of cookery. As one pupil has expressed it: "I have found the lessons wonderfully helpful in

SWEET POTATO CONE

classifying and fixing facts in my mind, and I feel that I am much better grounded in the principles of cookery than I ever should have been by merely studying cook-books."

After such a beginning, each one reading a cook-book will instinctively select and add to the foundation principles, already acquired, such explanatory details as are best adapted to her home conditions.

CARD CATALOG OF FOODS

The up-to-date housekeeper is ready to accept modern ideas and adapt methods from other departments of life to her business of housekeeping. She finds a card catalogue one of the simplest means for keeping addresses, and has another for an inventory of her household possessions, and a third for a list of foods especially suited to her family. In this list each card records not only the name of a food, but the approximate beginning and end of its season, its average price, the quantity required to serve a given number of persons, and several of the best methods of using it. Here, also, may be references to certain pages of the cook-books in her library. Or the cards may have copies of the recipes; such cards should have a hole in the top, so that they may be hung up in the kitchen within view of the worker.

When uncertain what to chose for the next day's dinner, or for some special occasion, she looks over these cards, and several possibilities will be suggested. From this plan one naturally comes to the study of dietaries and an application of the principles laid down in *Food and Dietetics*.

POTATO PEARS

Other mashed vegetables may be served in like manner

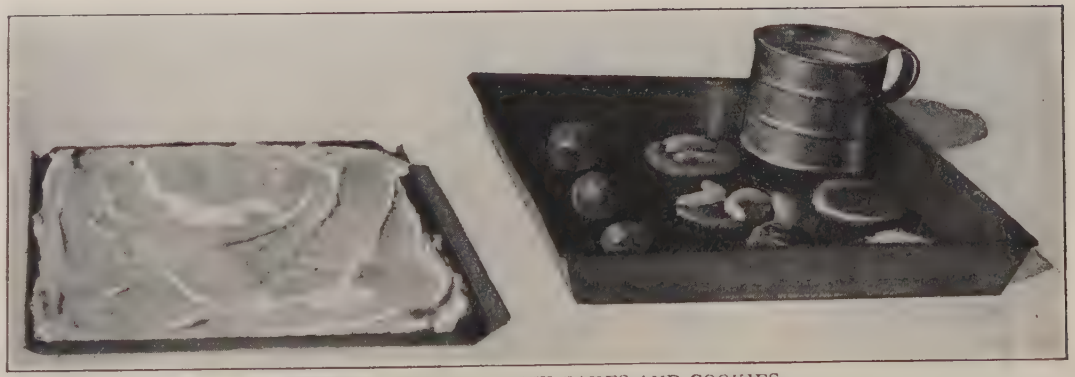
Among the helps in study along these lines are the series of dietary studies which have been issued from time to time by the office of Experiment Stations, United States Department of Agriculture, Washington, D. C. Two of the best to begin with are Bulletin 28 (Revised), "The Chemical Composition of American Food Materials" (5 cents), and Bulletin 129, "Dietary Studies in Boston, Springfield, Philadelphia, Chicago" (10 cents). The latter gives menus for several days at different prices, with itemized list of materials used and cost of each.

These may be obtained by sending coin to the Superintendent of Documents, Washington, D. C.

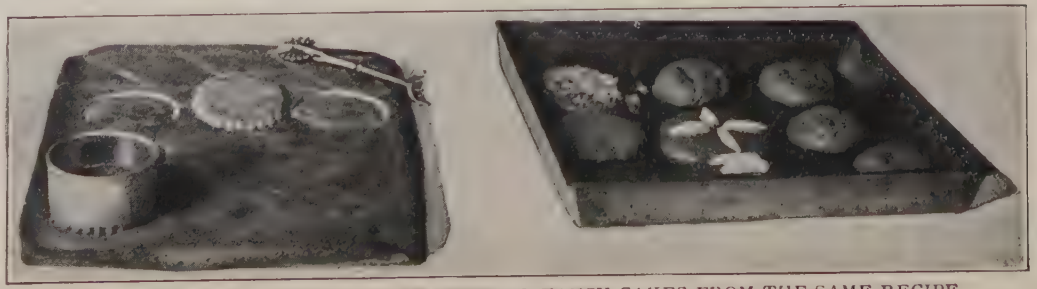
COOKERY A FINE ART

In cookery, quite as much depends upon the order and manner of combining the materials as upon the ingredients themselves. The manipulation of the cook-stove has something in common with that of a musical instrument. It is possible to play by ear with little knowledge of scales and chords, or to cook without knowing the laws of heat or the chemical composition of food materials.

Or, by continual practice, a single composition may be committed to memory and be reproduced in a mechanical fashion either upon the piano or on the kitchen range. Only after much study and repetition of processes does one become able to interpret intelligently the works of great masters, and the fundamental laws of harmony must be known, before one



BEFORE BAKING. FANCY CAKES AND COOKIES



AFTER BAKING. HOW TO MAKE SEVERAL FANCY CAKES FROM THE SAME RECIPE

can produce new creations either in music or more material things.

As music appeals to the sense of hearing, so does cookery to that of taste. The truest art in cookery is not the ability to construct wondrous complications of food materials, or to carve roses from beets, or model faces in butter, but rather to develop the full flavor of a food by the simplest process, to make the "mouth water"— that is, to stimulate the flow of the digestive juices by savory odors and flavors.

Brillat Savarin well said that the invention of a new dish meant more happiness to the human race than the discovery of a constellation, but quite as important is the constant preparation of the simple, old foods in the very best way — the baked potato, the boiled egg, the broiled steak, etc., etc.

CAKE MAKING.

The mixing of cake often has more to do with its texture than the proportion of materials used, though both have their influence.

It is an interesting experiment to make a good cooky dough and bake portions of it with different proportions of flour. Take, for example, the familiar 1-2-3-4 cake formulas and transpose the flour and eggs so that we use one cup of butter, two cups of sugar, three eggs and four cups of flour. The stiffness of this dough will vary with size of the eggs and the quality of the flour. Often some liquid and more flour are added, making a less rich mixture, and then

some baking-powder or its equivalent will be needed, otherwise the creaming of the butter and the eggs will bring sufficient air into the dough.

Even before all the flour is worked in, some of the dough may be spread on a tin and cut in shapes after baking. When slightly stiffer, bits of the mixture may be dropped on the tin, fruit or nuts put over them, and they will spread out in dainty little cakes.

If still more flour is added, but before the dough is quite firm enough to use a rolling-pin, small balls of the dough may be shaped round with the hands and flattened on the pan with the under surface of a smooth tin cup.

A dough in this stage may be chilled, and then can be rolled easily, and the resulting cakes will be much richer than if more flour had been worked in.

Deft, experienced hands produce satisfactory results with doughs, because they can shape them without working in an excessive amount of flour.

MENU MAKING

Through the test questions, the attention of our pupils has been called to the planning of meals for a household, for this is an important part of the housekeeper's duties. Under Part I we asked for menus introducing as many dishes as feasible containing milk and cheese. Such menus would be useful where the meat markets were poor and milk abundant, since one may thus secure similar nutritive elements, and usually at less expense than for meats.

After Part II, the request was made for a menu for two days when eggs were cheap, and for two days more when they were expensive. This was done because few housekeepers pay sufficient attention to market prices. They get the idea that a certain food is costly, and therefore not to be used at all, when, perhaps, a careful comparison of the prices of all ingredients would show it to be cheap at some seasons. Angel and sponge-cakes, for example, when eggs are at their lowest price, are less expensive than average butter-cakes.

With eggs at 25 cents a dozen and butter at 25 cents a pound, a sponge-cake with five eggs costs no more than a cake with two eggs and half a cup of butter. If the whites of twice as many eggs are used, the actual cost is no greater, since the yolks are available for other purposes.

At the close of the lessons we asked for a week's menu from each householder represented, with suggestions for their improvement, without increase of labor or expense.

The responses show an increased attention to the details that count in feeding a family satisfactorily to all concerned.

Yet menu-making is still a great bugbear to many pupils, and a few more hints on the subject may be helpful.

Many are hampered seriously by the habits and wishes of different members of their households.

One young woman writes: "My father demands griddle cakes every morning the year round."

Naturally, with such tastes, it is difficult to introduce many new dishes, or to secure a very varied menu.

In the old days of the brick oven, most of the necessary cooking for a family was done on one day of the week, for the proper heating of that oven could not be accomplished hurriedly.

Now with the gas stove, conditions are very different, and two or three hours each day should be ample time for the actual cookery for an average family. But to accomplish everything in these limits wise planning is required. Whatever requires long cooking for breakfast must be started the previous day, and preparation for the dinner or luncheon is begun while breakfast is being made ready, and so on.

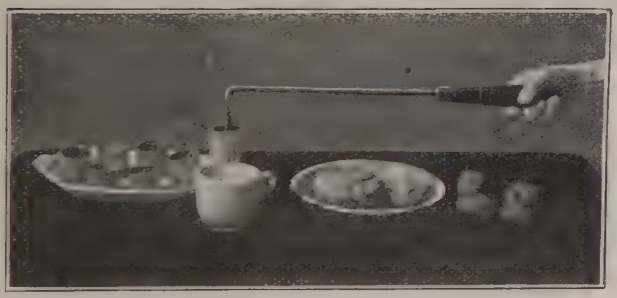
Many business women keep house in this way, and their families are as well fed as those where more time is frittered away on petty nothings. It is only by application of business methods in our kitchens, that the routine in many households can be simplified and untangled.

The preparation of food for an average household is not a difficult matter when the manager has learned her trade and each individual member is not unreasonable in his or her requirements.

The housekeeper must think out her plan of action

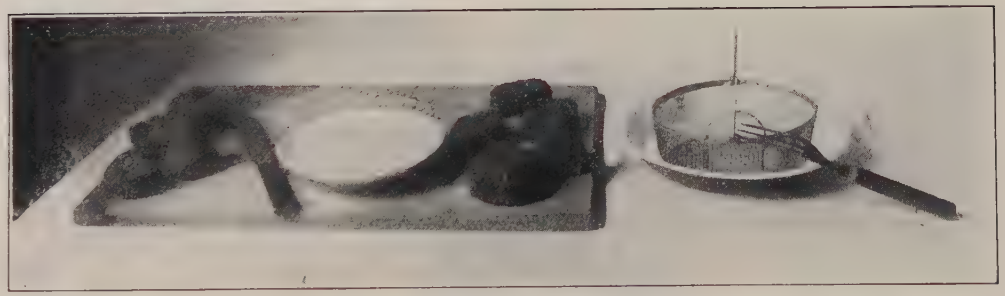
for days in advance and thus save unnecessary duplication of processes.

When one pair of hands must do all the cooking, it is a foolish waste of time and strength to cook fresh food for the purpose of making composite dishes. Let those come occasionally as an easy way of finishing up some bits too good to throw away, which have already appeared in other forms. For example, it



Making Timbale Cases.

takes no more effort or fuel to boil twelve potatoes than is required to cook six. These may appear one day as plain boiled, if we have a roast with a good gravy. The next day we are to serve the meat cold or perhaps fried fish with no sauce, so the second portion of potatoes is cut in cubes or slices and reheated in butter, flavored with onion, and sprinkled with chopped parsley just before serving, giving us Lyonnaise potatoes. Or we might prefer Delmonico potatoes and put them in layers in a pudding dish with



READY FOR MAKING CROQUETTES

SOME WAYS TO USE STALE BREAD

a sprinkle of cheese between, pour a thin white sauce over, cover with buttered crumbs, and heat through in the oven. Or the potatoes may be mashed and for a second appearance take the form of a huge cone, or apples, or pears for individual service.

Sometimes in our zeal to use up left-overs, we expend much time and strength and more additional material than the value of the original article warrants. But if one owns a timbale iron, those fragile shells resulting from frying a batter on it are attractive receptacles for a little creamed chicken or a sweetbread.

Croquettes have their place occasionally, and often save the purchase of more meat and thus justify the time they require. A garnish of crisp triangles of toast around a dish of creamed meat disposes of both the scraps of meat and bits of bread — or cases may be made of bread and browned in the oven and filled with meat.

The store closet should be kept well stocked, and this is less expensive and far easier than buying things as needed. One order a week ought to be enough for the staple groceries, and two orders a week in winter and three in summer for meats, fruits, and fresh vegetables. Do not order by telephone, but at least once each week visit the market and make the order according to what is available there.

The time often spent in a daily visit to markets or

BOSTON BAKED BEANS

a daily call from the store-man can be used to better advantage in an average home.

A fair supply of good-grade canned goods should be kept in the house for emergencies; but as a whole these are more expensive than fresh cooked meats and vegetables; but where fuel is expensive and labor high, they may be used more freely.

Milk should be used generously. Many families would do well to double their present milk supply. Where milk is abundant and canned vegetables at hand, it takes but a few moments to prepare a nourishing and attractive cream soup of corn, beans, peas, or tomatoes. If the top of the milk has been used for cereal and coffee, the remainder will be quite as satisfactory as whole milk for soups or puddings, when butter or other fat is added.

If our home is at a distance from markets and we have an abundance of one type of food material and little of others, then it may be necessary for us to devise many ways of serving this one, and then we must use different forms and flavors that we may not tire of the monotonous diet. But when the season of any fruit, vegetable, or meat is brief, then we need serve it only in its natural form or cooked in the simplest manner.

As the seasons change, cold merging into heat and heat into cold again, we let our fires go out, then we kindle them, and we decrease and then increase our clothing. But few households make a corres-

pondingly marked change in their food, adapting it to the differing needs of the body as the external temperature changes.

All of us know places where pork and pies occupy as prominent a position on the tables in July as in January, though their heat-giving qualities make them out of place in summer, even if admissible in winter.

Some Ways of Serving Oranges.

"Pork and beans," where the fat predominates, may be suitable for midwinter, while "baked beans," with a small amount of fat — be it pork, beef, butter or olive oil — are not out of place at any season.

Another phase of this matter is the improvement in flagging appetites, which is accomplished by a change in food. The city dwellers are often better off in the spring than the country family. From the South to the city markets come greens of several kinds, asparagus, lettuce, cucumbers, and radishes, while the country garden is still bare. A small bunch of asparagus as a garnish around some inex-

Lambs Heart with Asparagus.

pensive meat like lamb or calf hearts will give relish when a larger quantity would be an extravagance.

Those who prepare the food for the family deserve a change of labor from season to season, and many women in the country would do well to strike from pie making and spend the time so saved out of doors. It is no harder to care for a strawberry bed than to

Apricot or Peach Jelly.

wield the rolling pin or bend over a hot stove, and strawberries may well be substituted for pies.

True economy must be practiced in the planning of menus and one thing fitted into another so that nothing is lost.

USE OF FATS

Perhaps there is no one thing more often wasted in the average household than fat, yet this is essential to our health, and we pay high prices for it in cream, olive oil, and butter, when cheaper forms might be substituted in some cases.

The fat trimmed from meats is too often left at the market or thrown away after cooking, instead of clarifying it according to the directions on page 73 This, when properly prepared, would be far superior to the lard and cooking butter often bought for culinary purposes.

The flank fat from beef, or "cod fat," as some market-men call it, is much softer than suet, and, if carefully prepared, is to be preferred to cooking-butter for making ordinary cookies, gingerbread, pastry, etc. This clarified fat usually costs less than ten cents a pound, even after the weight of the scraps is deducted.

When a housekeeper has not time to prepare such fat, she may buy *uncolored* oleomargarine at about half the price of table butter, or in the vicinity of fifteen cents a pound. (Colored butterine is taxed ten cents a pound.) Many preparations of cotton

FRUIT SPONGE

Interior View Open

A WINDOW COLD-AIR BOX, MADE OF GALVANIZED IRON (Price $3 50.)

seed oil are on the market, which are satisfactory when fresh for frying and for use in doughs.

One must use discretion in combining fats for different uses. It is not desirable to use smoked fat like that from bacon, or highly seasoned fat, such as comes from sausages, for frying doughs, but these should be kept each by itself and used for warming potatoes and other vegetables.

The hard suet and soft chicken oil clarified together give an excellent compound, which may be substituted for butter in tomato sauce and some soups, as well as in many doughs.

In the same way all bits of meat and bone should be used for stock, alone, or combined with vegetables. Where meat is served once or twice daily in a house, there is rarely need of buying any especially for soups.

TABLE SERVICE

The desirability of careful table service for the simplest foods is shown by this incident told by one pupil.

"My aunt had great difficulty in getting us to eat cereal for breakfast, so she bought us each a very pretty blue bowl. We were allowed to use these only when we had cereal for breakfast. The result was that we eagerly asked for it every morning and now are very fond of the various kinds."

No one can deny that such attention to details is an important part of the housekeeper's duty.

Where there are no servants, a housekeeper must

be careful that her efforts for dainty service do not involve her in labor beyond her strength. Each member of the family should have a part in the table service that everything may move smoothly.

MENUS FOR SPECIAL OCCASIONS

Every housekeeper occasionally has to plan a special menu for home or club or church society, and consideration of this matter may be helpful here.

It is of first importance that we do not undertake more than we can carry out well. This applies to the choice of the food material, to the number of courses, and the way in which they are to be served.

Instead of sending away for rare luxuries with which our guests might be familiar every day, let us make the most of the specialties of our own locality.

The table decorations may take the form or color of the season, but beware of special shapes or garnishes which might cause any deterioration of the food to be served.

Other essential points are to have everything served at the proper temperature, to alternate brown and white or crisp and soft effects, and to avoid having the same article appear in two different courses.

This couplet from an old English poet sums up the whole matter:

"Three dishes well dressed, and a welcome withal,
Both pleaseth thy guest, and becometh thy hall."

GENERAL DIRECTIONS

FOR

WAITRESSES AT THE LAKE PLACID CLUB

By Mrs. Melvil Dewey

Secretary, Lake Placid Conference on Home Economics.

To serve food at the right temperature, both hot and cold, with neatness and the least possible noise and delay, constitutes the true art of the waitress. It is a problem in economics requiring careful study that there may be no waste of time and energy.

To Lay the Table. Put on silence cloth, then table cloth with middle folds in the center and the center ornament of ferns or flowers. Arrange places symmetrically. Place knives with sharp edge in, and spoons, with bowl up, at right of plate, forks with tines up, at the left, all one inch from edge of table. Napkins in the center. Glass at right just above point of knife, bread and butter plate at left above forks. Place three sets of salts and peppers on each table, one set at each end and one in middle for long tables; for round tables one third distance apart. Have bread, butter, and water carafe on table at every meal. Fill carafe and butter plates the last thing. Serve cream in individual pitchers, and have a china pitcher of milk on table for breakfast and supper. Leave wafers, jelly, and relishes on table as well as bread, butter, and water.

Waiting on Table. Keep cool, move noiselessly, wear rubber heels, avoid all clatter of dishes. Study your table carefully, see that everything is in place, that sugar bowls, salt and pepper sprinklers, vinegar and oil cruets are filled, that the extra dishes needed, silver, and finger-bowls are on the side table, and that neatness prevails.

While waiting, a chair may be drawn back from table at least three feet, and waitress may sit till guests for her table enter dining-room. Never sit near enough to touch the table. Rise as your guests approach, seat the eldest lady or head of the party, pass the menu card to her or the one who usually orders first. Fill glasses and serve butter while menu card is examined. Put only small piece of ice in each glass, enough to cool it, unless more is requested. Some prefer water without ice; study preferences.

Stand at the left when you pass or receive dishes. Stand at the right when you set down tea, coffee, plates or other dishes. A safe rule is, pass from the left, set down from the right. Place dishes in neat orderly straight lines.

Begin with a lady or older person.

For Breakfast, bring fruit and cereal orders together. If near kitchen, a second trip may be made for the hot cereals.

Place finger-bowls when fruit and cereal is set down and take orders for next course.

Before leaving the room at any time see that each

guest is provided with all needed for the previous course, whether finger-bowl, sugar, cream or spoon for cereal or coffee, and that bread, butter, water (the constants for each meal) are sufficient.

Remove finger bowls and soiled dishes before placing next course.

For the meat course set down plates from right and pass each dish from which guest is to help himself at his left. Leave plates of rolls, muffins, and bread on table, always, not on side table.

The last thing at end of each meal, remove plates and place finger-bowls one third filled, with doily under bowl, before each guest.

Remove every soiled dish from the table as soon as the purpose which it has served is over.

Never reach across the table in front of a person.

In lifting glasses and pitchers never put fingers on the rims.

For Dinner, general directions are the same. Bring soup individually, pass wafers, and take orders for next course.

Where meat orders vary, bring an individual platter if for one only, on larger platter according to number to be served.

Bring vegetables in covered dishes and pass in order seated, beginning, when convenient, with a lady or elder person. Reverse order of passing occasionally that the same person may not always come last.

Study the tastes and individuality of each person and anticipate needs if possible.

Unless asked to do so, do not bring individual dishes for vegetables except for one person who may come specially early or late. Bring in covered dishes, only enough food for orders given; take out and replenish with hot food as other orders are taken.

Leave bread and butter plates till after salad course.

Remove everything before dessert except needed silver and glass. Brush crumbs lightly from table to clean plate with napkin or doily before dessert is placed.

Serve coffee after dessert.

Place finger bowls as at breakfast.

Study each person's order as though for yourself and see that everything needed to go with it is at hand, salt, pepper, vinegar, oil, sugar, cream, spoon, knife, fork, finger-bowl, whatever the course may require.

Avoid extra trips to kitchen or serving-room for one article. See that everything required for that course is on tray before you leave.

In removing dishes much waste can be avoided by a little care. Trays should not be piled up high so that breakage occurs from dishes sliding off. Jellies, pickles, nuts, salads, olives, butter, bread, and food served on dishes other than the one from which it is eaten, should be taken to special table in serving-room or kitchen and cared for by pantry assistant.

If there is not room to take them out on tray without piling other dishes over or mussing them, put on lower shelf of side table and leave till another trip or for tray boy.

SUPPLEMENTAL PROGRAM ARRANGED FOR CLASS STUDY ON

PRINCIPLES OF COOKERY

Ample material for a course of six or more lessons may be secured from the lesson books on *Principles of Cookery* and from the Government Bulletins. The Farmers' Bulletins may be obtained without charge by writing to the United States Department of Agriculture, Washington, D. C. As many copies of each will be sent as desired. The bulletins for which a price is given may be obtained by sending *coin* to the Superintendent of Documents, Washington, D. C. The Government will not accept postage stamps. A few reference books are mentioned which will be loaned by the School for the cost of postage given, if not available in the local public library. Any encyclopedia will furnish much on every subject, and a book of standard quotations will also add to the interest of the meeting.

All the common daily foods may be studied from the historical or literary standpoint, for each has a history and literature of its own. Often it is wise to set the practical housekeeper to look up the historical side of a food, while a philosophical member is required to report upon its practical use. Thus each gets a fresh point of view and a new interest in an old subject.

It might prove interesting to arrange for a series of lunches to illustrate the foods being studied. Here it is best to keep out of the conventional lines and make the menus educational. When the class is large, a few may be chosen to prepare the lunch for all and directed to keep the expense within certain limits, 10 to 20 cents apiece, and to give a report. Chafing dishes should be provided for each group of four to eight and some experimental cookery tried.

MEETING I

(Study pages 1–39)

Fuels and Appliances for their Use

Work of Count Rumford:— Rumford Kitchen Leaflets, No. 1. ($1.00, postage 8c.)

Work of Benjamin Franklin. See encyclopedias.

Aladdin Oven. See Science of Nutrition, by Edward Atkins. ($2.00, postage 14c.)

Fireless Cook Stove. Pamphlet, postage 4c. See also Supplement to *Principles of Cookery.*

The Gas Stove. If gas is in common use, have members calculate the amount of gas required to bake a loaf of bread, a cake, to boil two quarts of water, etc., by observing the length of time taken to burn two cubic feet — i, e., one complete revolution of the hand of the small dial D. See page 10. See also Question 5.

Electric Cooking — Technical World Magazine, July 1906. (Postage 6c.)

Water

Experiments: See pages 21, 22. Test the water boiling slowly and boiling hard with a thermometer. Note the simmering temperature and observe how much less heat is required to keep the water at this temperature than to keep it boiling vigorously. (If a gas stove is not available, use a small kerosene stove or a chafing dish burner.) A suitable thermometer may be obtained through the school for 50 cents. Loaned for 6c postage.

The experiment on page 22 can be made with one dish using the same quantity (say a cup) in each case.

Topic: Kitchen Experiment.

References: Chemistry of Cooking, by Williams. Chapter II. Boiling of Water. ($1.50, postage 12c.)
Drinking Water and Ice Supplies, by Prudden. (75c., postage 6c.)

Preserving

Canning of Fruit, Preserves and Jellies, Maria Parloa. Farmers' Bulletin No. 203, *free.*

Improved Method of Canning, in Farmers' Bulletin No. 262.

Use and Abuse of Food Preservatives. Extract No. 221. Free, Department of Agriculture, Washington, D. C.

MEETING II

(Study pages 39–54)

Milk

Make sour milk cheese and junket. (See page 44.)

Show how acid may be used with milk without curdling. (See page 45.)

References: Farmers' Bulletin No. 42, Facts about Milk; No. 74, Milk as Food; No. 29, Souring of Milk and other Changes in Milk Products; No. 63, Care of Milk on the Farm; No. 210, The Covered Milk pail; No. 227, Clean Milk. Milk and its Products, by Wing. ($1.00, postage 10c.)

Butter

See experiments page 50.

White Sauce: In a chafing dish, or over a small kerosene or gas burner, make white sauce by three methods described on page 51.

To what extent may other less expensive fats be substituted for butter.

Make white sauce with oleomargarine.

Have some member make two or three small cakes from the same recipe. In one use butter, in another oleomargarine, in another a mixture of equal parts of lard and beef suet. Bake all at the same time and have all conditions as nearly the same as possible. Show results.

Topic: French Sauces and their Inventors. See Hand Book of Domestic Science, by Wilson, page 69. ($1.00, postage 10c.) And other books.

References: Extract No. 44. Butter Substitutes.

Sanitary and Economic Cooking, by Mary Hinman Abel. Chapter on Fats and Oils. (40c., postage 6c.)

Cheese

Make and serve Welsh rarebit made from different recipes, using the same kind of cheese, or make two lots by the same recipe and method, using two or more grades of cheese

See Question 17.

Exhibit: Show samples of all possible kinds of cheese; prices and composition.

Topic: Ways of using Cheese in Cookery. See Sanitary and Economic Cooking and Cook Books.

References: Farmers' Bulletin No. 82, Curd Test in Cheese Making; No. 144, The Curing of Cheese; No. 162, Cheese Prints; No. 202, Manufacture of Cottage Cheese; No. 244, The Food Value of Cottage Cheese, No. 166, Cheese Making on on the Farm.

Chemistry of Cooking, by Williams; Chapter IX. Cheese. ($1.50, postage 2c.)

(Select answers to Test Questions on Part I and send them to the School for correction and report on experiments.)

MEETING III

(Study pages 55–82)

Eggs

See experiments on cooking of eggs in water, page 57.

Try similar experiments in "frying" eggs with fat at high and low temperature.

See Question 6.

Show egg mixtures as custards, sponge cakes, etc., cooked at too high a temperature and the same ingredients cooked at correct temperature.

References: Farmers' Bulletin No. 128, Eggs and their Use as Food; No. 103, Preserving Eggs; No. 122, Flavor of Eggs; No. 262, Color of Eggs.

Meat, Fish, Fowl

Sanitary and Economic Cooking, "Methods of Cooking Meat," by Mary Hinman Abel. (40c., postage 6c.)

See Cook Books.

Farmers' Bulletin No. 34, Meats: Composition and Cooking; No. 85, Fish as Food; No. 182, Poultry as Food; No. 193, Cooking Meat; No. 162, Cooking Meat.

The Roasting of Beef, by Isabel Bevier. Circular No. 71, University of Illinois (postage 2c.).

Topic: Methods of Cooking Cheap Cuts of Meat in Palatable Form.

MEETING IV

(Study pages 83–97)

Vegetables

See experiments, pages 83–84.

Get up an exhibit of uncommon vegetables.

Illustrate the effect of overcooking vegetables by boiling a peeled potato,—one until it is just soft, another until it becomes soggy.

Topic: History of the White Potato.

References: Farmers' Bulletin No 256, Preparation of Vegetables for the Table, by Maria Parloa. Farmers' Bulletin No. 121, Beans, Peas and other Legumes as Food, by Mary Hinman Abel; No. 127, Sweet Potatoes; No. 244, Cooking Qualities of Potatoes; No. 73, Losses in the Cooking of Vegetables; Extract from Year-Book, 1900, Value of Potatoes as Food.

Grains

History: See "Corn Plant" by Sargent. (75c., postage 6c.)

Experiment: Cook cereal breakfast food for twenty minutes as directed. Start another portion the night before and cook for two hours, heating before serving. Compare results.

References: Farmers' Bulletin No. 249, Cereal Breakfast Foods; Extract 324, Wheat Flour and Bread; Extract 326, Macaroni Wheat.

The Cooking of Starch in Cereals, Extract No. 7, Illinois Experiment Station. (Postage 2c)

(Select and send answers to Test Questions on Part II.)

MEETING V

(Study pages 99–122)

Bread

Demonstration: Illustrate proportion of flour and liquid for (1) Batters, (2) Muffin Mixtures, (3) Soft Dough, (4) Pastry Dough. See pages 99–100.

See experiments with Leavening Agents, page 108.

If members are in the habit of making their own bread, hold a bread contest, appointing judges to grade the bread according to the chart designed by Professor Isabel Bevier for the Illinois Domestic Science Association, viz.

Flavor	35
Lightness	15
Grain and Texture	20
Crust—	
Color, Depth, Texture	10
Crumb—	
Color, Moisture	10
Shape and Size	10
	100

Size of pan recommended, $7\frac{1}{2} \times 3\frac{1}{2} \times 2\frac{3}{4}$ inches.

Pastry and Cake: Illustrate the difference between bread and pastry flour by making two cakes exactly alike and baking at the same time.

Illustrate the effect of a quick and a slow oven on the same dough.

Topic: Use of thermometers.

Bread: Quotations from prose and poetry by members.

References: Farmers' Bulletin No. 112, Bread and the Principles of Bread Making; No. 114, Skim Milk in Bread Making.

Story of a Grain of Wheat, by W. C. Edge. ($1.00, postage 10c.)

MEETING VI

(Study pages 122–138)

Food and its Appeal to the Senses

The importance of flavor, etc., as an aid to digestion: See The Work of the Digestive Glands, by Pawlow, the "Psychic or Appetite Juices." ($2.00, postage 16c.) Also Food and Dietetics, by Hutchison. Pages 396–397. ($3.00, postage 26c.)

Cut illustration of cooked food from magazine to be discussed and criticised by members.

Topics: The Use and Abuse of Garnish in Food.
Harmony in Colors, Flavors and Odors in our Foods.
Salads.
Use of Left-overs.

Menus

See Supplement.

Menus for a week: Have each member give her method of planning meals.

Menus for Social Occasions.

Topics: Economy of Time and Strength in Cooking.
Is Hospitality a Lost Art.
Serving by different Methods. Illustrated

References: Hostess of To-day, by Linda Hull Larned. ($1.50, postage 16c.)
Home Science Cook Book, by Anna Barrows and Mary J. Lincoln. ($1.00, postage 10c.)

(Select answers to Test Questions on Part III and report on supplemental work and experiments.)

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FREEHAND COOKING

THE purpose of this Bulletin is to tabulate the material in *Principles of Cookery* and to give the comparatively few fundamental recipes in cooking which are capable of infinite variation.

Exact proportions, conditions, and materials are essential to obtain identical results in cooking, but materials vary somewhat and conditions differ, so that it is often necessary to modify a recipe. By "free hand cooking" is not meant hit or miss cooking, or cooking by guess, but the compounding of food materials on scientific principles—not following blindly by "rule of thumb" recipes which may have been made for different conditions.

WEIGHTS AND MEASURES.

3 teaspoons=1 tablespoon	2 pints=1 quart
16 tablespoons=1 cup	4 quarts=1 gallon
2 cups=1 pint	1 cup=8 ounces (volume)

A gallon of water weighs 8 1/3 pounds—a cup of water, 8 1/3 ounces (avoirdupois). A gallon contains 231 cubic inches.

All materials are measured level, i. e., by filling cup or spoon more than full and leveling with a case knife. This applies to liquids which "round up" in spoons. Flour, meal, and fine sugar are measured after sifting. Measuring cups are not always accurate and ordinary tea and tablespoons vary considerably.

Test spoons with each other and with the cup before using.

APPROXIMATE MEASURE OF ONE POUND.

2 cups milk	2 5/6 cups granulated cornmeal
2 cups butter	2 2/3 cups oatmeal
2 cups chopped meat	6 cups rolled oats
2 cups granulated sugar	4 1/3 cups rye meal
2 2/3 cups brown sugar	1⅞ cups rice
2 2/3 cups powdered sugar	2 1/3 cups dry beans
3½ cups confectioners' sugar	4 1/3 cups coffee
4 cups patent flour	8 large eggs
4 cups entire wheat flour	9 medium eggs
4½ cups Graham flour	10 small eggs

Note.—Read "tablespoons" in place of cups in the above and the weight is about 1 ounce.

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No table of weights to measure can be more than approximate, as different samples vary in weight for bulk. In truly scientific cookery quantities should be measured by weight. The table is useful for comparison, i. e., powdered sugar is more bulky than granulated and less so than confectioners', hence the greater sweetening power of granulated; ordinary white flour (sifted) is less bulky than graham flour, and so on.

Experiments have shown that there may be a difference of 25 per cent in the weight of a "cup of flour" measured by different persons in different ways. One method is to sift the flour onto a square of glazed paper (or oil cloth) and pour it into the cup placed on another piece of paper—tap the side of the cup once with a knife and level.

METHODS OF APPLYING HEAT

BROILING—Cooking before or over glowing coals or under gas. Radiant heat. High temperature at first to sear outside, thus developing flavor and retaining juices; then lower temperature for the heat to penetrate and to avoid burning.

PAN BROILING—Cooking on very hot griddle with only sufficient fat to prevent sticking.

ROASTING—Same as broiling, superseded by baking in oven.

BAKING—Cooking in oven by heated air and radiation.
Slow oven, 270°—350° F.
Moderate oven, 350°—400° F.
Quick oven, 400°—480° F.
(These temperatures were taken by a thermometer through the top of a gas stove oven).

BOILING—Cooking in boiling water, 212° F.

STEWING—Cooking in water at temperature 160° to 180° F.

STEAMING—Cooking in contact with steam, 212° F.

DRY STEAMING, as in a double boiler, 192° F.

FRYING—Cooking by immersion in deep fat, approximately 360° F. for uncooked foods, 380° F. for cooked foods. The fat used: all lard, 2/3 lard and 1/3 bef suet, "cod fat" from the flank of beef, oil, "snowdrift," "cottolene" and mixtures. Temperatures vary to produce similar effects with different fats.

SAUTE-ING—Cooking in small quantity of fat—often called frying.

BRAISING—Combination of stewing and baking. Meat is often first seared to develop flavor and prevent escape of juices.

FRICASSEEING—Combination of sautéing and stewing.

COMPOSITION OF RAW FOODS

Parts in 100 (approximate).

Wheat Flour—12 water, 12 gluten, 75 starch, 1 fat.
Cornmeal—12 water, 9 protein, 75 starch, 2 fat.
Beans and Peas, dry—13 water, 24 legumen, 60 starch, 2 fat.
Potato, white—78 water, 2 protein, 18 starch, trace of fat.
Parsnips, Carrots, Turnips—85 water, 1 proteid substance, 9—12 starch and sugar, ½ fat.
Banana—75 water, 1 protein, 22 sugar and starch, ½ fat.
Loin of Beef (avg.)—60 water, 18 protein, 20 fat.
Eggs—74 water, 13 albumen, 10 fat.
Egg, white—86 water, 12 albumen, no fat.
Egg, yolk—50 water, 16 albumen, 33 fat.
Milk—87 water, 3 casein, 5 sugar, 4 fat.
Cheese—33 water, 26 casein, 33 fat.
Nuts—3 water, 20 protein, 15 starch, 55 fat.
Butter—12 water, 1 protein, 85 fat.
Lard, Olive Oil—100 fat.

All the above foods except refined fats, sugar and starch, contain from ½ per cent to 1 per cent of *mineral matter* (salts), apparent when the foods are burned as *ash*. Butter and cheese have 2 per cent or 3 per cent of common salt added.

Protein foods are eggs, meats, fish, cheese.

Starchy foods are the grains—wheat, rice, rye, oats, corn, etc., beans, peas, potatoes, chestnut.

Fats are prominent in fat meats, nuts, cream, butter, lard, vegetable oils.

Cellulose or woody fiber is found in vegetables, unscreened flours and meals, and in fruits, especially when unripe.

EFFECT OF HEAT ON FOOD MATERIALS

Starch absorbs water, swells and becomes partially soluble in water. This begins at about 150 degrees F. Dry starch begins to change to dextrine at about 320 degrees F.

Sugar is not changed at low temperatures unless acid is present. It melts at about 365 degrees and begins to caramelize at about 420 degrees F. Sugar, boiled with acid, changes slowly to glucose or non-crystallizing sugar.

Cellulose itself is not affected by cooking, but the connecting substances are softened and it may be separated.

Protein foods are hardened somewhat by heat. Albumen coagulates completely at 160 degrees F. and will no longer dissolve in water. Other proteins, as *gluten* of flour, *casein* of milk, *ligumen* of peas and beans, *myosin* of meat, are hardened somewhat.

Gelatin is formed from *gristle* and *connecting tissue* of meat, and from bones, by long continued heating in the presence of water.

Fat is not changed except at a high temperature, when it is broken apart—"split"—into fatty acid and glycerine. Some of the glycerine is changed into "acrolein" at very high temperatures, 500° and over, which is very irritating to the mucous membrane, as is recognized by the smarting sensation given to the eyes and nose when fats are overheated. Butter begins to "split" at about 256° F., lard at 360° F., beef suet at 440° F., cottolene and snow drift at 450° F., especially prepared cotton-seed oil and olive oil at 600° F.

Baking Powder, a mixture of cooking soda and an acid substance, as cream of tartar, or phosphates, or alum, undergoes chemical change, whereby carbon dioxide is set free and salts—as Rochelle salts, or phosphate, or alumina compounds—are formed. The heat of the oven expands the air or gas in the food, evaporates part of the water and drives out volatile substances like alcohol.

All these changes are, for the most part, physical rather than chemical in their nature. For example, in a cake after baking, the sugar is still sugar, the starch is still starch, the fat is still fat, and the albumen is still albumen. All the materials have been blended, flavors having been developed through minor but complex chemical changes and a small proportion of the starch and sugar in the crust have been changed to dextrin and caramel.

TEMPERATURE AND TIME OF COOKING

All food materials are poor conductors of heat—it takes time for the heat to penetrate.

The correct time and temperature depends on (1) what

is to be accomplished, (2) size and thicknesses, i. e., the extent of surface exposed to the heat, compared to the bulk.

Foods with a large proportion of eggs require low temperature to prevent toughening.

Starch requires nearly the temperature of boiling water for cooking.

No food containing much water can be raised to a temperature above the boiling point—212 degrees F. Water gives off vapor at all temperatures, but at 212 degrees F. steam forms rapidly and in so doing absorbs a large quantity of heat. No brown crust can be formed until the water from the surface is nearly all evaporated. A full oven in which much water vapor is being given off requires the application of more heat than when only one or two dishes are in it.

In baking doughs, the larger the mass the lower must be the temperature in order that the heat may have time to penetrate to the interior and expand the gas and harden the albumen and gluten. If the temperature is too high at first, a crust forms, preventing the proper expansion of the loaf and hindering the penetration of the heat.

Thin loaves, pieces of meat, etc., need much less time for cooking, because the heat penetrates quickly. Higher temperatures may be used, as the food is cooked before the surface begins to be burned.

Mixtures containing much sugar or molasses burn easily.

Vegetables containing much fiber need long boiling to soften them and separate the cellulose. Young, green vegetables contain less fiber and require less time in cooking

Bearing all the above in mind, the following tables may serve as a general guide for beginners. When it is possible to do so, TEST.

TIME TABLE.

BOILING

Meats (4 to 5 lbs.)—2 to 5 hours. (Tough meats should be kept below boiling, 180° F.)
Fish (2 to 5 lbs.)—30 to 45 minutes.
Ham (12 to 14 lbs.)—4 to 5 hours.
Corned Meat (6 to 8 lbs.)—4 to 6 hours.
Potatoes, white—20 to 30 minutes.
Potatoes, sweet—15 to 25 minutes.
Peas, green—20 to 60 minutes.
Beans, string—½ to 1 hour.
Beets, young—45 minutes.
Beets, old—3 or 4 hours.
Onions—40 to 60 minutes.
Cauliflower—20 to 25 minutes.
Cabbage, cut up—20 to 25 minutes.
Turnips, parsnips—30 to 45 minutes.
Carrots—1 hour; less if young.
Green corn—8 to 15 minutes.
Spinach—15 to 20 minutes.
Squash—20 to 30 minutes.
Asparagus—20 to 30 minutes.
Diced Vegetables—10 to 20 minutes.

BAKING

Beef rib (medium, 4 lbs.)—1 hour, 15 min.
Beef rib (medium, 8 lbs.)—2 hours, 15 min.
Leg of lamb—1 hour, 30 minutes.
Pork (rib)—3 to 4 hours.
Veal (leg)—3 to 4 hours.
Chicken (3 to 4 lbs.)—1 to 1½ hours.
Turkey (8 to 10 lbs.)—2 to 3 hours.
Fish (3 to 4 lbs.)—45 to 60 minutes.
Braised beef—4 to 5 hours.
Bread, white—45 to 60 min. depending on shape of loaf.
Bread, Graham—35 to 45 minutes.
Quick Doughs—8 to 15 minutes.
Cookies—8 to 10 minutes.
Cake, thin—15 to 30 minutes.
Cake, loaf—40 to 60 minutes.
Pudding, Indian, etc.—3 hours or more.
Bread Pudding—20 to 45 min., depending on shape and number of eggs.
Pies—30 to 45 minutes.
Scalloped Dishes—15 to 20 min.
Baked Beans—12 hours or longer.

OVEN TEMPERATURES.

	ENTER AT	KEEP AT
Roast Meats	480° F.	350° F.
Fish	425° F.	350° F.
Bread	440° F.	400° F.
Popovers	480° F.	450° F.
Cookies, Puff Paste	480° F.	450° F.
Quick Doughs	480° F.	480° F.
Ginger Bread and Molasses Mixture	380° F.	380° F.
Plain Cake	380° F.	380° F.
Sponge Cake	350° F.	340° F.
Baked Custard	350° F.	Higher in water

These temperatures are for gas ovens, with thermometer through the top. An oven door "thermostat" should register from 50° to 70° less. Few of these are accurate in their readings, but after being tested a few times they are useful in obtaining desired temperatures thereafter.

In addition to the methods of processes of applying heat, there are a few fundamental processes in cooking, i. e., thickening, leavening, shortening and flavoring.

THICKENING AGENTS

The common thickening agents are flour, corn starch, rice flour, potato flour, arrow root, eggs; also gelatin, sea moss, junket for milk, and pectin of unripe fruits stiffen liquids on cooling.

Proportions

One level tablespoon of flour will thicken one cup of liquid for soups.

Two level tablespoons of flour will thicken one cup of drippings or other liquid for gravies and sauces.

Five level tablespoons of *browned* flour will thicken one cup of liquid for gravy.

The thickening power of corn starch is about twice that of flour.

Four level tablespoons of corn starch will stiffen about one pint of liquid, as in corn starch pudding.

Two good sized eggs to one pint of milk make a custard—one egg to a cup for soft custard or baked cup custard; three eggs to a pint of milk for a large mold custard.

One level tablespoon of granulated gelatin will stiffen about one pint of liquid, if cooled on ice.

LEAVENING AGENTS

Doughs are made light or porous in the following ways:

(a) By the production (and expansion by heat) of carbon dioxide gas from the combination of baking soda with some acid substance.

(b) From carbon dioxide gas produced by the growth of yeast—a microscopic plant.

(c) From the expansion of entangled air, incorporated in the dough by means of (1) beating batters; (2) folding thick doughs; (3) beating air into eggs, especially the whites—then folding them into the mixture.

(d) From the expansion of water to steam.

Proportions

Use two level teaspoons baking powder to one cup of flour.

Use one teaspoon less of baking powder for each egg added after two have been used.

Use one-half teaspoon soda with one and a quarter teaspoon cream of tartar.

Use one-half teaspoon soda with one cup sour milk.

Use one-half teaspoon soda with one-half cup molasses.

Two teaspoons baking powder are equivalent to one-half teaspoon soda in the above combinations.

The yeast plant grows best at 75 to 90 degrees F. It changes *sugar* into alcohol and carbon dioxide gas. Flour contains a small proportion of sugar and during bread making some of the starch is changed into sugar, but the yeast begins to act more quickly if a little sugar or glucose is added at first. Salt and fats in quantity hinder the growth of the yeast. Low temperatures stop the growth almost completely; high temperatures kill the plant.

When eggs are used as leavening agents, the whites are beaten separately, as they will hold much more air than the yolks, and folded into the mixture the last thing, breaking as few air cells as possible.

When air is depended on for leavening agent, all materials are kept as cold as possible. Cold air expands more on heating than warm air. In pastry making, heat also melts the fat, so that the dough cannot be handled.

SHORTENING

Fats are added to doughs to make the product brittle—friable—"short," and to enrich the mixture. The fat counteracts the adhesive properties of the gluten and starch in flour.

Pastry flours contain less gluten than bread flours and so require less shortening.

Butter and oleomargarine contain about one-eighth water and salt, and thus have less shortening powers than lard, drippings, snowdrift, cottolene, etc., which contain no water.

Proportions

Two cups of flour (eight ounces) made into puff paste requires eight ounces (one cup) of shortening.

Two cups of flour in ordinary pie crust requires four ounces (one-half cup) of shortening.

Two cups of flour in cookies requires four ounces (one-half cup) of shortening, or less.

Two cups of flour in cake requires about three ounces of shortening.

Two cups of flour in short cake requires two ounces (one-fourth cup) of shortening, or more.

Two cups of flour in tea biscuits requires one-half to one ounce (one to two tablespoons) or more of shortening.

In yeast doughs less shortening is used—from one-half to an ounce to two cups of flour. The tenacity of the gluten is required to hold the carbon dioxide gas slowly formed by the yeast, hence too much shortening prevents proper rising.

Shortening for batters may be *melted* and mixed in, but in doughs which are to be rolled—pastry, cookies, short cake, biscuit, etc.—the fat should be *cold* and hard and cut into the flour with a knife, or rubbed in with the tips of the fingers.

FLAVORING

The flavoring materials most commonly used are salt, sugar, spices and extracts. The fine art of cookery consists of developing the full natural flavor of the foods themselves and in combining them in pleasing ways.

The amount of salt to be used depends, in general, on the *total volume* of the food. When food tastes salty, too much has been used. A safe proportion is one teaspoon salt to one quart of liquid in soups, sauces, or to one quart of flour in doughs, and for cereals one teaspoon to each pint of water used. When the flavors are delicate, somewhat less salt is used, and with strong flavors, somewhat more. Cakes in which much salt butter is used do not need more salt.

The quantity of sugar to be used depends on the taste desired. Foods served frozen need more sweetening than when at ordinary temperatures. On the other hand, foods that are served warm taste somewhat sweeter than when at ordinary temperature.

RECIPES

The following recipes were furnished by Miss Anna Barrows, teacher of cookery, Columbia University, author of *Principles of Cookery*, or adapted by the editor from the various standard recipes used in cooking schools:

WATER: EXTRACTING FLAVOR.

Tea.

Heat an earthenware teapot with hot water. Empty it and put in one teaspoon of tea for each measuring cup of fresh *boiling* water. Let it stand in a warm place two or three minutes. Strain and serve at once. If the tea boils or stands too long with the leaves it is unfit to drink.

Coffee.

Use one-fourth cup of coffee for one pint of water. Place fine ground coffee in strainer in the coffee pot; add actually boiling water *slowly*, a spoonful or two at a time. Cover between additions Pour through a second time if desired stronger.

Or: Mix one-fourth cup coffee and one teaspoon beaten egg with a little cold water, add the remainder of one pint of water boiling hot. Let it boil up, pour from the spout and turn back into the pot and leave for ten minutes where it will keep hot but not boil.

Stock.

Stock is the basis for all soups, except milk or cream soups, to which it is sometimes added. From a pint to a quart of cold salted water is used to each pound of meat and bone, both of which should be in small pieces. Let stand one hour, heat slowly and simmer gently for four hours or more, strain and cool quickly. Remove the hardened fat before using. About a cup of mixed vegetables—carrot, onion, parsley, celery, etc.—may be added during the last hour. Mixed herbs and spices, as bay-leaf, blade of mace, two or three cloves and pepper corns, may be tied in cheese cloth and removed from the liquor when sufficient flavor has been extracted.

Bouillon—usually made from beef with little bone and no vegetables. Brown Stock—some of the meat and a part of the vegetables browned in hot fat or marrow. White Stock—made from chicken, veal, or fish; no flavoring which gives color added. Macaroni, Vermicelli, Noodle, Rice, Barley Soup and the like—cook about one-fourth cup of dry material until tender and add a quart of hot stock, or use cooked left-overs. Julienne Soup—one-half cup mixed cooked vegetables cut in cubes, strips or fancy shapes, to one quart of stock.

RESTORING WATER.

Dried Fruits and Vegetables.

Pick over, cover with cold water, leave for half an hour, then wash thoroughly, inspecting each portion and drain. Again cover with cold water and soak 12 to 24 hours, and then cook slowly until tender. Add sugar if desired for sauce when nearly done, or use like fresh fruit for pies, shortcake, etc.

Prunes, apricots, peaches, apples, pears and vegetables are treated in this way.

THICKENING.

Sauces.

Methods of mixing: (1) Melt butter (or other fat) in saucepan, stir in dry flour, cook and stir until frothy all over, then add liquid slowly, hot or cold, while stirring; cook again until thick, stirring until smooth.

(2) Rub butter and flour together and stir into the warm liquid in a double boiler, then cook and stir until thick and smooth.

(3) When cream or less butter is used, rub the flour smoothly with a little cold liquid and stir into the remainder, which should be hot, and cook in double boiler until smooth. Then add butter and seasoning.

Thin Sauce: One level tablespoon fat, one tablespoon flour and one cup liquid, one-fourth teaspoon salt, few grains pepper (white).

Suitable for creamed potatoes, macaroni, toast, etc.

Medium Sauce: Two tablespoons fat, two tablespoons flour and one cup of liquid. Seasoning.

For general use with fish and vegetables.

Thick Sauce: Two to four tablespoons of fat and three or four of flour for each cup of liquid, either milk or milk and stock.

This is the basis of souffles and croquettes.

White Sauce may be varied by different flavors and garnishes, such as capers, celery, mushrooms, oysters, lobsters, etc., etc.

Tomato for the liquid in sauce may be seasoned with onion, herbs and spices, by cooking them with it for a short time before straining.

Spanish Sauce is tomato sauce with the addition of onion and peppers.

Dutch or Hollandaise Sauce: To one cup white or milk sauce add one or two beaten egg yolks and cook in double boiler like custard. Flavor with one tablespoon lemon juice.

Brown Sauce for Roast or Pan Broiled Meats: After placing the meat on the platter drain out any fat in the pan and put some water to soak off the browned juice and flour.

For each cup of gravy put two tablespoons of the fat in a saucepan and brown two tablespoons of flour in it; then add one cup of the water from the pan. Cook like white sauce. Season as desired with salt and pepper.

Or, Melt and brown two tablespoons of butter in a saucepan; add two or three tablespoons of flour and continue the browning. When coffee color, add one cup water or stock or milk.

Welsh Rarebit.

Heat one-half cup of cream in the blazier of a chafing dish or in a skillet, add one tablespoon of butter creamed with one teaspoon of corn-starch, one-fourth teaspoon of salt, and a few grains of cayenne. When thick, set over the hot water or heat very slowly and add one-half pound of soft mild cheese cut up fine and one-half teaspoon of mushroom ket-

chup or Worcestershire sauce or one-fourth teaspoon of mustard. Stir until the cheese is melted and pour over crackers or thin toast.

Cream Soups.

Cook the vegetable till soft and rub through a strainer, using all or a part of the water in which the vegetable is cooked, except with potatoes. Combine with an equal quantity of white sauce or white stock or mixture of the two. Season. If too thick, add hot milk. Beaten egg may be added just before serving if too thin.

Asparagus, Carrots, Cauliflower, Celery, Corn, Cucumbers, Lettuce, Mushrooms, Onions, Spinach, Summer Squash, Turnips, Water Cress.

Cream of Peas, Beans, Lentil, Potato and other thick soups have half quantity or less of white sauce added to keep the materials from settling.

Cream of Chicken, Fish, etc., made of stock from bone, skin and other inedible portions combined with about equal quantities of hot white sauce seasoned in various ways.

Corn Starch Blanc Mange.

Blend two tablespoons cornstarch with an equal bulk of milk, heat remainder of one cup milk in double boiler. Stir the hot milk into the moistened starch, return to double boiler, stir on stove till thick, put over water, cover and cook twenty to thirty minutes or longer. Add two tablespoons sugar, a bit of salt, flavor and put in moulds.

Variations: For liquid use part thin cream and part strong coffee, or all fruit juice.

Put layers of raw or cooked fruit alternately with the blanc mange in the moulds.

Blend two tablespoons of cocoa with the sugar before it is added to the cornstarch mixture.

Irish Moss Blanc Mange.

To soften the moss, soak one-half cup in cold water, wash pick over and cook in one pint of water in a double boiler for about half an hour. Strain and make up to a quart with scalded rich milk or thin cream; add a teaspoon of extract

flavoring and one-fourth teaspoon of salt. *Or* cook the softened moss directly in one quart of milk, season and strain. Put in molds.

Use of Gelatine.

One level tablespoon granulated gelatine will stiffen about one pint liquid. Different makes of sheet, shredded, granulated and powdered gelatine may be used interchangeably by weight. A larger proportion of gelatine is required for large moulds than for small. A little salt improves most gelatine combinations.

Soak gelatine in cold water until soft, dissolve by adding boiling liquid, sweeten and flavor with coffee, lemon, or other fruit juices and pulp. Keep the proportions of gelatine and total liquid right. A little more gelatine is required in hot weather, unless ice is used.

Such jellies may be served with whipped cream or boiled custard. Every package of gelatine is accompanied with directions for its use.

Fruit Pudding.

Make a jelly flavored with fruit juice, slightly increasing the proportion of gelatine. As it begins to stiffen, combine nearly an equal amount of fruit with it. With each half cup of jelly may be used one date, one-half fig, two or three almonds, one-fourth orange, one-fourth banana, etc.

Snow Pudding or Fruit Sponge.

Beat one egg stiff and add one cup half stiffened jelly gradually. Or, beat the jelly till frothing and blend the stiff egg with that. Mould and chill. Serve with soft custard sauce made of the egg yolks.

Bavarian Cream.

Stiffen a soft custard, or fruit juice, or combination of the two, with gelatine. As it begins to stiffen, fold in stiff whipped cream.

Baked Custards.

Scald one pint milk. Beat two eggs till smooth, add one-fourth cup sugar, a bit of salt, and blend with the hot milk. Strain into buttered molds, set in a pan of hot water

and bake until firm. Put a thin knife blade in center of custard and if done no milk will adhere to the blade as it is removed.

The same proportions may be used for custard pies, or may be combined with cooked rice for a pudding.

Soft Custard.

Use the same proportions as for baked custards, or three egg yolks in place of two whole eggs. Pour hot milk over the beaten eggs, stirring constantly. Sugar may be added before or after cooking the custard.

Return milk and egg to the double boiler and cook, stirring all the time until the custard thickens and coats the spoon, three minutes or longer. If cooked too long the custard will curdle. Cool quickly. Flavor before serving.

Egg Timbals.

Use only one-fourth to one-half cup liquid, milk or stock, for each egg. Flavor with salt, pepper, etc. Cook like custards, turn from mold and serve hot with tomato sauce.

Thickened Custards.

Filling for Cream Puffs, Layer Cake, Sauces, Ices, etc.

Make a smooth paste with one-fourth cup flour and a little milk and scald the remainder of one pint of milk. When it is hot, blend carefully with the flour and cook in a double boiler twenty minutes or more. Then combine with the beaten yolks of two or three eggs and stir steadily while cooking three to five minutes longer. Take from the fire and sweeten and flavor according to its use. For filling for a layer cake one-fourth cup sugar may serve, while for cream puffs one-half cup or more will be needed.

The same foundation may be combined with an equal quantity of cream or of fruit juice, or of each, made very sweet and frozen as ice cream.

Frozen Desserts—General Directions.

All mixtures must be sweeter and more highly flavored than if served without freezing. Cool thoroughly before packing in ice and salt. Use three measures fine cracked ice to one measure of salt.

Lemon Ice.

Mix in proportion of the juice of one lemon, one-fourth cup of sugar and one cup of water. *Or,* make a quantity of syrup, 4 measures of sugar to 2 of water, and use 4 measures of syrup to 1 of fruit juice. Strain into a tin can or straight glass jar with a close cover. Pack this in a pail or pan with ice (or snow) and salt. Turn the can around and occasionally scrape down the ice which forms inside. Use other fruit juices in the same way—orange, pineapple, raspberry—to which lemon juice is usually added, grape juice or acid jelly.

Pineapple Sherbet.

One can of grated pineapple, one cup of sugar, juice of two lemons, one tablespoon of powdered gelatine, one quart of water or milk.

Ice Cream.

Scald thin cream in double boiler, dissolve sugar in the proportion of one cup to a quart, add flavoring when cool—extract, one tablespoon to a quart. This is "Philadelphia" ice cream. Thickened custard made very sweet and highly flavored is often called "New York" ice cream.

Mousse or Parfait.

Mix together one cup thick cream, two tablespoons powdered sugar and flavoring. Whip cream with egg beater, skimming off froth as it rises and draining on a sieve. Return liquid to bowl and whip until no more froth will rise. Turn drained froth into a mould; cover, and bind the lid with a strip of muslin dipped into melted fat. Bury in ice and salt for three to four hours before serving.

Junket.

The active principle in junket is rennin or "rennet," which is extracted from the lining of calf's stomach. This will coagulate or thicken warm milk but nothing else. Its properties are destroyed at the boiling temperature and it has no action in the cold. Heat two cups of milk to body temperature, 99 degrees, powder junket tablet and dissolve in a little water, add one-third cup of sugar dissolved in one-

third cup of warm water and flavoring extract. Pour into serving dishes and keep warm until set. Cool.

Caramel syrup or maple syrup may be used in place of sugar. Chocolate may be added or beaten egg yolks with beaten whites on top.

Jellies.

Pectin is the gelatinizing agent in jellies and jams. It is a substance similar to starch and is found in most fruits and some vegetables. It is most abundant when fruit is just ripe or nearly so. The making of good jelly depends on having the correct proportion of fruit juice, sugar, and *acid* and on boiling. The density of the mixture should be between 24 degrees and 30 degrees as measured by the syrup gage at the boiling temperature, and the boiling point 217 degrees F. or 103 degrees C. Long boiling alters the gelatinizing properties of pectin. Too great a proportion of sugar and violent boiling cause the sugar to crystallize in the jelly.

Pick over and clean, or pare, core and cut up large fruits, heat with or without water and cook until very soft. Juicy fruits like currants and grapes need no added water, while fruits like apples should be barely covered with water. Strain the juice from the pulp through cheese-cloth or flannel. To the strained juice granulated sugar is added usually in the proportion of pint to pint, but good jelly may be made with half the volume of sugar to juice. The proportion depends on the acid and sugar in the fruit. Heat slowly to dissolve sugar, and boil gently until proper density is obtained, skimming froth that rises. If no syrup gauge is used, test by dropping a little on a cold plate to see if the jellying point is reached. Pour into sterilized glasses and when set cover with melted paraffine.

The pulp may be squeezed in the straining bag to get a marmalade or even a second quality jelly; or, better, heat pulp again with a small amount of water and strain without pressure. This process may be repeated. Boil down somewhat and add sugar and finish as before. Jelly may be made from parings and cores.

As the presence of acid is essential to make the materials jelly, lemon or currant juice is usually added to sweet flavored

fruits. (Summary of the result of experiments made by Dr. Goldthwaite at University of Illinois and Miss Snow at University of Chicago).

Soft Cooked Eggs.

Place eggs in one cup of boiling water to each egg in a saucepan, cover and remove from the fire.

From five to ten minutes will be required according to the firmness desired.

Or, put one egg in one cup of cold water and bring slowly to the boiling point. Then remove the egg.

Hard Cooked Eggs.

Keep eggs in water just below the boiling point for thirty minutes. The yolks should be dry enough to mash easily. Such eggs are suitable for salads—may be warmed in any well flavored sauce, may be stuffed by blending the yolks with chopped meat or nuts or seasoning of any kind.

THICKENING AND LEAVENING.

Omelets.

There are but two types of omelet to which special names are given from the garnish added.

French Omelet.

Beat an egg slightly. Add one tablespoon water or milk, season with salt and a dash of pepper. Turn into a hot buttered frying pan, which must be perfectly clean and smooth. Lift cooked portions with a fork. Shake the pan to prevent adhesion. When all is firm, fold and serve at once.

Puffy Omelet.

Separate white and yolk of one egg. Beat white stiff, add yolk and blend together. Add salt, pepper and one tablespoon of water or milk. Turn into buttered pan and place where it will cook slowly and evenly. When firm, fold and serve.

Two tablespoons of white sauce or bread softened in milk may be used instead of one of milk or water. Chopped parsley, or other vegetable, any nice bits of meat or fish, cheese, jelly, etc., may be folded into the omelet just before serving.

Meringues or Kisses.

Beat egg whites with a speck of cream of tartar. When stiff fold in one-fourth cup powdered sugar for each white. Flavor slightly, drop on ungreased paper, and bake slowly until dry, thirty minutes or more.

For soft meringues on puddings, use half as much sugar.

Fruit Souffles.

For each stiffly beaten egg white fold in one-fourth cup thick, sweetened fruit pulp, or marmalade, or jam. Partly fill buttered molds, and bake like custards, until firm.

Serve with soft custard as a sauce.

Sponge Cakes.

Equal measures of eggs, sugar and flour, or the weight of the eggs in sugar, and half of the weight of the eggs in flour. This also applies to the use of egg whites only as in angel cakes.

In other words, two large or three small eggs rightly blended with one-half cup each of sugar and flour and carefully flavored and baked slowly will produce such a cake as that shown on page 65.

The yolks of the eggs should be beaten until thicker and lighter colored than when beginning the process. To them add the sugar, one or two teaspoons of lemon juice and a bit of grated rind. Over the whites of the eggs sprinkle a bit of salt and beat until stiff. Fold them into the yolks and gradually sift the half cup of flour over, blending carefully without stirring. Put into the pans and bake in a gentle heat for twenty minutes, if in small cakes; twice as long if in one mass.

Cream Puffs.

In a saucepan heat one-half cup water with two ounces of butter or less. When boiling hot mix in one-half cup of flour and continue to stir while it cooks into a smooth mass. Cool till it will not cook eggs and mix in one egg and a second and beat the whole vigorously with the spoon. Shape on greased pan some distance from each other in six to twelve mounds and bake about thirty minutes according to the size. They should be light and dry when taken from the pan, otherwise they will shrink and be heavy.

QUICK DOUGHS—GENERAL PROPORTIONS.

	Flour	Baking Powder	Liquid	Shortening	Sugar	Eggs
Pop Overs	1 cup	.....	1 cup	.....	.....	1
Timbale Cases	1 cup	.....	½ cup	1 tbs.	1 tsp.	1 or 2
Griddle Cakes	1 pint	3 tsp.	2 cups	2 tbs.	1 tbs.	1 or 2
Muffins	1 pint	4 tsp.	1 cup	1 tbs.	.....	.....
Muffins (richer)	1 pint	2 or 3 tsp.	¾ cup	1 or 2 oz.	¼ cup	1 or 2
Cake	1½ cups	2 tsp.	½ cup	2 oz.+	¾ cup	1 or 2
Doughnuts	1 pint	2 tsp.—	½ cup	.....	½ cup	1
Cookies	1 pint +	2 tsp.	¼ cup	2 oz.	½ cup	½ to 1
Tea Biscuit	1 pint	3 tsp.	⅔ cup	½ oz.+	.....	.....
Shortcake	1 pint	3 tsp.	⅔ cup	2 oz.	.....	.....
Pastry	1 pint	.....	½ cup	4 oz.	.....	.....

Biscuit.

Two cups sifted flour, three teaspoons of baking powder, one-half teaspoon of salt; sift together, rub in one tablespoon of shortening—butter, oleo, lard or drippings. Mix as soft as can be handled with about two-thirds cup of milk or water. Turn onto a floured board, roll gently to three quarters inch thick, cut and bake. Pastry flour makes more delicate biscuit than bread flour.

Dumplings for Stews: Omit shortening, add milk until dough may be dropped from the spoon into boiling stew. Cover and cook rapidly 10 minutes.

Shortcake: Rub in one-fourth cup of butter in biscuit mixture. Cut like biscuit for individual shortcakes or use a square pan and divide with knife dipped in melted butter so that portions may separate readily after baking.

Use shortcake mixture for covering to meat pies, apple dumplings, etc.

Muffins.

Sift together two cups of sifted flour, two teaspoons of baking powder, one-half teaspoon of salt, and one-half tablespoon of sugar, add one tablespoon of melted shortening, one beaten egg and one cup of milk. Mix thoroughly and bake in quick oven.

Blueberry Muffins: Use a little less milk in muffin mixture and add one cup of blueberries and a little more sugar. Chopped apples or other fruit may be used in same way.

Tea Muffins: Use one-fourth cup each of sugar and shortening and two or three eggs in the muffin mixture.

Graham Drop Cakes.

Sift together one and one-half cups of graham meal, one-half teaspoon each of salt and soda, one-fourth cup of brown sugar. Mix into a stiff batter with one scant cup of sour milk. Drop from spoon on buttered pan, or into gem pans and bake in a quick oven 15 minutes.

Cereal Gems.

Use even quantities of flour and softened cooked breakfast food, one teaspoon of baking powder to a cup of material, add sufficient milk to make a batter which will drop from the spoon. Mix thoroughly and bake in hot buttered gem pans.

Boston Brown Bread.

Sift together one cup of cornmeal, one cup of rye meal, or entire wheat flour, one teaspoon of soda, one-half teaspoon salt. Mix with one-half cup molasses and one cup sour milk. If not soft enough to smooth out in the bowl, add a little water. Put in greased tins with tight cover and steam three hours or more.

Corn Cake.

Sift together three-quarter cups each of cornmeal and flour, one-half teaspoon each of salt and soda, one tablespoon of sugar. Mix with one beaten egg and one cup of thick sour milk or cream. Bake in muffin pans or single pan, twenty to thirty minutes, according to thickness.

The cornmeal may be scalded with an equal volume of boiling water, left to cool, or over night, and more shortening, two eggs and a little sugar may be added.

Griddle Cakes.

Into one pint of sifted flour mix one-half teaspoon of salt, three teaspoons of baking powder and one teaspoon of sugar. Beat two eggs until very light, turn into one cup of milk without stirring, add the mixture to the flour with two tablespoonsful of melted butter; beat well, and add more milk to make a batter about like thick cream. Beat vigorously, especially before each frying.

Fry on hot griddle, grease with rind of pork or ham. Drop batter from end of the spoon, making circular cakes. Turn when full of bubbles.

Waffles.

Are cooked on a waffle iron, using the griddle cake mixture.

Plain Cake ("Lightning" Cake).

Place the flour sifter in the mixing bowl and put in it one and one-half cups of flour, three-fourths cup of fine granulated sugar, two level teaspoons of baking powder, one-half teaspoon of salt. Sift into the bowl.

In the measuring cup, melt one-fourth cup of butter (or oleo), break in two eggs, fill up the cup with milk. Add one-half teaspoon flavoring extract or saltspoon of spice. Mix with the dry ingredients and beat well two or three minutes. Bake in sheet or greased muffin tins in quick oven.

VARIATIONS: Add two tablespoons of cocoa, or an ounce of melted chocolate. Use one cup caramel or maple syrup in place of sugar. Leave out part of the sugar for Cottage Pudding.

Cookies.

Rub one-half cup of butter until creamy, gradually add one cup of sugar, then put in one egg and beat together thoroughly. Next add, alternately, one-half cup of milk or water and one pint of flour, in which two teaspoons of baking powder have been sifted. Use enough more flour to make a soft dough, from one to two cupfuls, according to the nature of the flour, roll out thin, cut with a cookie cutter or in fancy shapes, and bake in a quick oven.

VARIATIONS: Before all the flour is added, divide into four portions; to one add one teaspoon of lemon extract, to another one-half cup of desiccated cocoanut; one-half ounce of chocolate melted, or a teaspoon of cocoa, sifted in with a little flour; to the fourth, one teaspoon of mixed spice and one-half cup of chopped raisins, etc. Or flavor the portions with ginger, almond with chopped almonds on top, or with dates, figs, nuts. Or use less flour and drop from a spoon for a soft thick cake.

Gingerbread.

Sift together two cups of flour, one-half teaspoon each of salt and soda and one teaspoon of ginger. Mix with one cup of molasses and two tablespoons of fat softened in one-half cup of hot water. Bake twenty minutes or more in a moderate oven.

Doughnuts.

Sift together four cups of flour, one teaspoon of salt, three teaspoons of baking powder, one-half teaspoon of mixed spice and one cup of sugar. Mix with one egg and one cup of milk.

Sour milk and soda may be used in place of baking powder. For richer doughnuts, two eggs and one tablespoon of butter may be used.

Plain Pastry.

Sift two cups of flour with one-half teaspoon of salt and cut in with a knife, one-fourth cup or two ounces of shortening. Mix with about one-half cup of ice water into a stiff dough. Roll out and spread with one ounce of butter, fold and add a second ounce of butter in the same way, making one-half cup of shortening in all. For upper crusts more shortening may be rolled in if desired. Keep everything as cool as possible. The lightness of the pastry depends on the amount and coolness of the air enclosed and the flakiness on the number of layers of fat and dough produced by folding and rolling.

YEAST DOUGHS—GENERAL PROPORTIONS.

	Sugar	Shortening	Liquid	Yeast Cake	Flour	Eggs
Bread.....	1 tsp.	½ oz. +	1 cup	¼ to 1	3 cups	....
Muffins....	1 tbs.	½ oz.	1 cup	¼ to 1	2 cups	1 +
Rolls.....	1 tbs.	1 oz.	1 cup	¼ to 1	3 cups	....
Fancy Rolls.	2 tbs.	2 oz.	1 cup	¼ to 1	3 cups +	1 +
Buns.....	½ cup	2 oz.	1 cup	¼ to 1	3 cups +	....
Coffee Cake	¼ cup	2 oz.	½ cup	¼ to 1	2 cups	2 +

Bread—For Each Loaf—Short Process.*

One cup of scalded milk, or half milk and half water, one-half teaspoon each of salt and sugar, from one-fourth to one whole cake of yeast according to time, softened in lukewarm water, and about three cups of bread flour. Mix thoroughly and knead until the dough is smooth and springy. The dough should be warm. Let rise till double, shape, put in pan, rise again and bake. If preferred, shape into a dozen to two dozen rolls.

Entire Wheat Bread.

Scald one cup of milk; in it melt one teaspoon of butter and half a teaspoon each of sugar and salt. When lukewarm, add half a cake of compressed yeast, softened in one-fourth cup of warm water. Stir in between two and three cups of flour to make a dough stiff enough to hold its shape. Mix thoroughly with a knife, but do not knead it until after it has risen to double its bulk, then shape into small loaves, let rise until double in size, bake in hot oven about half an hour.

One-fourth cup of molasses may be used in place of the sugar if preferred.

Rolls—Long Process.

In a bowl put one tablespoon of butter or lard, one tablespoon of sugar, one teaspoon of salt, and one pint of scalding hot milk. When cool, add one-quarter yeast cake softened in a little water, and three cups of flour. In the morning, or when light, add to this sponge about three cups more of flour, or enough to knead. Let rise till double in bulk, then shape, put in pans, rise again, and bake.

Muffins: Add two or three eggs to the sponge, but no more flour. Bake in muffin pans.

Coffee Cake.

Work into one pint of light dough, two-thirds cup of white sugar, one egg, and two ounces of melted butter. Mix thoroughly to a creamy, smooth batter by beating

Pour into shallow pan and let rise again. Sift sugar and cinnamon over the top and bake in a quick oven. Serve warm.

Use of Stale Bread.

Bread Cases.

Cut slices of bread two inches thick and three inches long. Remove part of crumbs from the center, leaving a hollow space. Spread with butter and brown in the oven.

Croutons.

Cut stale bread into slices about one-third inch thick and then in cubes. Bake in moderate oven until golden brown.

Dry Crumbs.

Crusts remaining from croutons, etc., should be dried in the oven, rolled and sifted, the fine ones used for croquettes, etc., the coarser for stuffing or escalloped dishes.

Cracker crumbs may be used in the same way.

Buttered Crumbs.

Melt butter and stir in crumbs till the butter is evenly distributed.

One ounce of butter for one cup of crumbs is a fair proportion. Buttered crumbs seasoned and moistened are used for stuffing peppers, tomatoes, fish, poultry, etc.

Filling for Fish or Fowl.

One cup of crumbs will serve for a small fish or chicken, while a large fowl or turkey will require two or three. With each cup of crumbs blend one ounce or more of butter or chopped fat salt pork, one teaspoon parsley or mixed herbs, one-half teaspoon salt and a little pepper. Moisten with milk, water or stock. For fish season also with lemon and onion juice.

Mashed potato or chestnuts may be used instead of crumbs.

Fat—To Try Out and Clarify.

Cut the fat—beef suet or flank fat—in small pieces, removing skin and bits of lean meat. Cover with cold salted water and leave in a cold place for several hours. Drain off the water, and if possible soak again, and drain. Cook slowly in moderate oven or in upper part of the double boiler till the fat has melted and the scraps are crisp, but not brown. Strain and cool. Slices of raw potato or pieces of charcoal cooked in the fat before straining will absorb any impurities.

Beef, pork and chicken fat may be combined. Surplus fat from roast beef, corned beef, etc., may be added.

Such fat may be used for shortening muffins, gingerbread, etc., for greasing pans, for some sauces and soups, or for deep frying. Mutton fat may be prepared to add to fry fat.

Fat from bacon, ham or sausages should be reserved for hashes or warming over potatoes.

MEATS.

Broiled Meats, Chops, Steaks.

The meat should be cut in convenient pieces, and some of the bone, gristle and fat removed. Sections one inch thick will be more juicy than thinner ones. Wipe the meat with a damp cloth, grease the broiler or pan with a piece of the fat, or brush melted fat over the meat. Place the meat where intense heat will reach it at first, under the gas flame, or in a hot pan on top of the stove, or over hot coals. Turn often at first, every half minute if directly over the coals, until well seared and browned on both sides, then move it farther away from the fire so the heat may penetrate to the center without burning the outside.

As the meat is seared on the surface the juices are driven towards the center, and expanding with the heat tend to make the surface of the meat puff outward. This is very apparent between the wires of a double broiler and probably is the best indication that the meat is cooked.

Steaks one inch thick should cook in five or six minutes to be rare, eight or ten minutes to be well done, the time

varying according to the method of cooking and intensity of heat. Mutton chops may be served rare, lamb usually well done, veal and pork always must be thoroughly cooked.

Broiled meats should be served at once on a hot dish and with slight seasoning beside their own juices. If kept hot the cooking is continued too far.

Fish and chicken may be partially broiled and then finished in the oven. Apply the direct heat mainly to the cut inside surface, as the skin burns easily.

Roast Meats.

Trim, wipe, score the fat portion and rub salt into that, place on rack in pan, sprinkle flour all over it, put skin side down. Have oven very hot at first to sear outside quickly to prevent escape of juice, then reduce heat. Baste occasionally as needed with the fat which cooks out into the pan, and turn the roast over to cook it evenly.

If there is danger of burning put some water in the pan after the meat is seared, but this is not necessary if heat of oven is lowered.

A sirloin or rib roast weighing five pounds will require about one hour, or longer, if it is to be well done. A surer rule for time of cooking is to allow fifteen minutes for each inch in thickness, or twenty minutes if wanted well done.

Braised Beef.

Use a thick section of the lower part of the round, two to four pounds. Trim, wipe and sprinkle with flour, season with salt and pepper. Brown under the gas or in hot fat. Put in casserole, partly cover with water or brown or tomato sauce. Cover closely and cook in very slow oven three to five hours.

Meat Stew.

Neck or breast of lamb of veal or inexpensive cuts of beef may be used in this way. Cover bones with cold water and heat slowly. Cut meat in convenient pieces, roll in flour seasoned with salt and pepper. Fry bits of fat, then

brown sections of prepared meat and onion if desired Put meat in kettle with bones when water is hot.

When nearly tender add carrot, turnip, peppers, or celery cut in small shapes about one cup each to one pound of meat.

Potatoes pared and cut in quarters may be added 20 to 30 minutes before serving, and dumplings 10 minutes before serving.

Escalloped Fish or Meat.

Equal measures of cooked minced meat, bread crumbs and white or tomato sauce; or, for one measure of meat, half as much sauce and one-fourth as much buttered crumbs. (Boiled rice or macaroni may be used instead of crumbs.)

Remove all uneatable portions from meat and mince or chop. Put in layers in a buttered dish, having crumbs for the last. Bake until heated through and brown on top.

Fish or Meat Loaf, or Timbales.

Remove skin, gristle and bone from meat or fish and mince fine. Combine with an equal quantity of bread crumbs or stuffing from a baked fish or roast fowl, season as desired, moisten with milk or stock. Add one beaten egg or more to each pint of the mixture. Pack in buttered moulds, steam or bake until firm in center. Turn out and serve with sauce.

Meat Loaf in Rice.

Line a mould with well-cooked rice. Fill with the meat prepared as above. Cover with rice. Steam an hour. Serve with tomato sauce.

Fish Balls.

In a stew pan put one pint potatoes, pared and quartered, and one cup salt cod fish which has been picked apart in cold water. Cover with boiling water and cook until the potatoes are soft. Drain in a colander till no water can be shaken out. Return to pan, mash thoroughly, add salt if needed, a shake of pepper, one teaspoon butter, one raw egg, and beat all together. Shape on a spoon or in small balls and fry in deep fat, hot enough to brown them in one minute. Drain on soft paper.

CEREALS AND VEGETABLES.

Breakfast Foods.

Usual proportions—one-half cup flakes or one-fourth cup granules to one cup water, one-fourth teaspoon salt to one cup water.

The denser the cereal, the more water and the longer the time required.

Bring water to boiling point in upper part of double boiler, placed directly on the stove.

Pour cereal slowly into boiling water, stirring constantly. Let boiling continue about five minutes till mixture begins to thicken. Place over boiling water in lower part of the boiler. Cover and cook gently with little stirring one hour or more, or till tender and soft. Or put in Fireless Cooker for three hours.

Serve hot, with or without sugar, with milk, cream or butter. Put in moulds with fruit and serve cold as dessert. Pack solidly in loaf shape, slice when cold, brown in hot fat, serve hot.

Corn Meal Mush.

Mix one cup cornmeal, one-fourth cup of flour, one teaspoon salt, one cup cold milk or water. When smooth blend with one pint boiling water, stir for about five minutes. When thick place over water or in steamers and cook one hour or more. Serve hot or pack in pan to fry, or dip in fat and toast under the gas.

Rice.

Pick over and wash thoroughly or parboil five minutes and drain. Then put in a buttered dish with twice its bulk of boiling water and set in a steam cooker. In three-quarters of an hour it should be tender and every kernel distinct, and it may be cooked longer without becoming mushy.

Rice Croquettes.

With one pint of cooked rice (if cold, reheated) blend one tablespoon butter and one or two beaten egg yolks. Season with salt, pepper and parsley, or with sugar and

spice. Divide in ten or twelve portions, press in firm shape, roll in egg and crumbs, and fry in deep fat.

Boston Baked Beans.

Soak one pint beans over night. Parboil in the morning until the skins crack readily with a slight pressure. A very little soda may be put into the water to help this process. Score the rind of one-fourth pound fat salt pork and rinse it. Drain the beans and put part in the bean pot, then the pork and cover with the beans, leaving only a little of the pork rind exposed. Mix one teaspoon of salt, one-fourth teaspoon of mustard and a tablespoon or more of molasses as desired, add water and pour over the beans. Cover and bake twelve hours or more, keeping the beans filled up with water until the last hour, when the cover should be removed and the pork rind and the top layer of beans should brown.

Potatoes.

Baked.

Choose those of equal size and scrub with brush. Cook in hot oven 30 to 40 minutes, or until soft. Then crack the skin to let out steam. The potato should be plump (not shriveled), and the inside white and mealy.

Boiled.

Wash, pare if imperfect or old. If not of uniform size, divide the larger ones. Put in boiling salted water and cook for 20 to 30 minutes, till tender. Drain off the water and shake the uncovered kettle to let the steam escape.

Riced.

Put boiled potatoes through strainer or ricer into a hot dish from which they are to be served.

Mashed.

In a hot pan mash boiled potatoes. For each half pint, add two tablespoons milk, one teaspoon butter, season with salt and pepper.

Croquettes.

Prepare mashed potato with less milk and one egg yolk for each half pint and season with celery salt, paprika and parsley. Roll in crumbs, egg and crumbs, and fry in deep fat.

Stuffed Potatoes.

Cut a slice from end of baked potatoes, scrape out inside, mash and season. Add chopped meat, cheese or parsley for variety. Refill skins and reheat in oven.

Canoes, or Potatoes on the Half Shell.

Cut the potatoes in two lengthwise, refill each part and brown.

Creamed.

Cut boiled potatoes in cubes or slices and reheat in thin white sauce, one-half cup to each cup of potato.

Hash.

Use two parts potato to one part meat, or equal amounts of each. Chop meat, chop or mash potato. Season with salt, pepper, onion, etc., moisten with gravy or water. For one cup hash, put one tablespoon fat in a frying pan. When hot, put in the hash and cook slowly, without stirring, until a brown crust forms on the bottom. Fold like an omelet.

French Hash.

Put meat and gravy in a deep dish, cover with mashed potato and bake till golden brown.

SUGAR.

Caramel.

Put sugar in a smooth iron pan over a hot fire and stir constantly with an old wooden spoon until melted to a light brown syrup. Scrape off any sugar that forms in lumps. When all is melted add an equal amount of boiling water and simmer a few moments until blended into a thick syrup.

A quantity of this may be made at once and kept on hand to flavor and sweeten custards and ice cream, or to serve as a sauce with other puddings.

If it should happen to brown beyond the shade of good maple syrup, let it go a little further until the sweet flavor

would be lost. Then dissolve as above and bottle to use for coloring soups and meat gravies.

Syrup.

Combine equal quantities of water and sugar in a saucepan and stir until dissolved. Boil five to ten minutes until only slightly reduced in quantity. Can while hot in small jars and keep on hand to sweeten fruit drinks or ices as the dissolving of the sugar in cold liquids is a slow and unsatisfactory process.

Fondant.

In an agate saucepan put one cup granulated sugar, about one-sixteenth of a teaspoon of cream of tartar—a bit the size of a small pea—and one-half cup of hot water. Stir till sugar is dissolved, then cover and cook without stirring. Skim and wipe the sides of the pan if necessary. Boil about ten minutes or till 238 to 240 degrees F., when it will form a soft ball in cold water. Turn into a greased bowl or platter and cool slightly. It will grain if stirred while too warm. Beat and knead till a smooth, creamy mass. If it hardens too rapidly dip the hands in water and continue the kneading.

Pack away in covered dish for a day or longer, then shape as desired. Colors and flavors must be very concentrated. By combination with chocolate, dates, figs, nuts, etc., a great variety of candies may be secured. This fondant is a very satisfactory frosting for cake and may be kept on hand. Warm it over water until it can be spread on the cake.

Boiled Frostings.

Cook one cup of sugar with one-half cup of water or less, and a bit of cream of tartar until it will thread, not quite reaching the soft ball stage. Then pour slowly on the stiffly beaten white of one egg and continue beating until cool enough to spread. Much depends on the moisture in the atmosphere as well as the dryness of the cake.

For a still softer frosting a larger proportion of egg white is used. This may be varied with different flavors and colors.

MISCELLANEOUS.

French Dressing for Salads.

One-fourth teaspoon salt, speck pepper, one tablespoon vinegar, two or three tablespoons oil.

Blend thoroughly and pour over the salad.

Mayonnaise Dressing.

One egg yolk, one-half to one cup oil, one tablespoon vinegar, one tablespoon lemon juice, one-half teaspoon salt, one-half teaspoon mustard, few grains cayenne.

Mix vinegar, lemon juice and seasoning.

Beat egg yolk, add oil drop by drop at first, beating continually. When thick add a little of the seasoning mixture, then more oil and alternate until all is used.

Utensils and materials should be kept as cool as possible.

Chocolate.

Melt one ounce chocolate in saucepan over hot water, add a few grains salt, one tablespoon sugar, one-half pint boiling water; stir till smooth; boil one minute. Blend with one pint hot milk and cook in double boiler.

Beat with Dover egg beater to prevent skin forming on top. Just before serving, an egg yolk may be added to the chocolate. Serve with whipped cream.

Chocolate and cocoa both contain starch which requires cooking.

FOOD AND DIETETICS

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AMERICAN SCHOOL OF HOME ECONOMICS
CHICAGO

January 1, 1907.

Dear Madam:

In the study of the lessons on Food and Dietetics, full use should be made of the many interesting and valuable publications of the United States Department of Agriculture These are divided into the popular bulletins and pamphlets sent free to all in the United States and the more technical bulletins for which a nominal price is charged.

The free publications are included chiefly in the series of Farmers' Bulletins and in Extracts from Year Books, etc. The "for sale" bulletins are issued by the various divisions of the Department of Agriculture, those on food chiefly by the Office of Experiment Stations and the Division of Chemistry.

Any or all of the free publications may be obtained simply by addressing the Department of Agriculture, Washington, D. C. For the "for sale" bulletins coin or money order must be sent to the Superintendent of Documents, Washington, D. C. Postage stamps are not accepted.

The full list of free and "for sale" publications will be sent on request by the Department of Agriculture. A fairly complete list of the publications on food is given in the bibliography, but new bulletins are constantly being published. Their numbers, titles and contents are given in the monthly list of new publications which is sent free on request.

Bulletins of the various state agricultural experiment stations cannot be obtained from the U. S. Department of Agriculture, but summaries are given of the more important of

these in the series of Farmers' Bulletins called Experiment Station Work, the contents of which are given in the list of free publications.

Of the "for sale" bulletins, two of the Office of Experiment Stations at least should be sent for--No. 28, American Food Materials, which gives the composition of all ordinary foods, price 5 cents, and No. 129, Dietary Studies in Boston, Springfield, Philadelphia and Chicago, price 10 cents,- interesting in connection with the cost of food. Farmers' Bulletin No. 142, The Nutritive and Economic Value of Food, should be read in connection with Part I.

The food problem is a large one and although nutrition by no means depends entirely upon the composition of the food eaten, knowledge of the character and composition of food is fundamental in the selection of a healthful diet. In the last analysis, the food problem must always be an individual one based on conditions and personal peculiarities.

If difficulties or questions arise in connection with this series of lessons, remember that you are always privileged to write to the School for assistance and advice.

Sincerely yours,

W. O. Atwater

Director

GENERAL VIEW OF THE RESPIRATION CALORIMETER, MIDDLETOWN, CONN.
From Year Book U. S. Department of Agriculture, 1904

FOOD AND DIETETICS

Problems of To-Day

THE problems of the household are more difficult to-day than they have ever been, for each advance in science, each modern invention, has brought in its train new responsibilities and new duties. In every department of the administration of the home more knowledge and skill are required than ever before. With the increase of conveniences has come increased care. Standards of living have changed as well, and greater perfection in all household service is demanded of the home-maker.

We still carry on in the household many of the numerous trades that were formerly a part of the home life, as cooking, cleaning, laundry work, sewing. At the same time more close supervision of the life of the children, mental, moral and physical, is required; more knowledge is needed to control materials if we would have that power over our environment which makes us the masters and not the slaves of our belongings; and the social demands upon time and strength can not be ignored.

The Simple Life

If to-day we would lead "the simple life," it must be as a result of determined effort, often in the face of more or less conscious opposition on the part of relatives and friends and of society in general.

Essentials and Non-Essentials

Yet a simpler life is not to be attained by ignoring the results of science, and refusing to apply the knowledge made available by the investigator; but rather by making use of every help that will give knowledge of the materials with which we work, that will cultivate the power to distinguish between the essential and the non-essential, and that will give control of the situation.

The Food Problem

The food problem is perhaps the most difficult of all the physical problems that present themselves in the household, partly because it is so vital to the welfare of the family, and partly because it is so inclusive. The food question once meant the providing something palatable and presumably wholesome at a cost within one's means. To-day it implies a knowledge not only of the cost and nutritive value of food materials, their composition and digestibility; but of the balanced ration, the proportion of different food principles necessary for perfect nourishment, and of the way in which this proportion should be varied to suit the needs of the child or of the aged, of the laborer, or of the student. An understanding of the principles involved in the preparation of food is demanded, as well as a knowledge of food adulterations that will insure pure food materials.

The importance of the question can scarcely be exaggerated. Mrs. Ellen H. Richards tells us that "the prosperity of a nation depends upon the health and morals of its citizens; and the health and morals of

a people depend mainly upon the food they eat, and the homes they live in. Strong men and women can not be raised on insufficient food; good tempered, temperate, highly moral men can not be expected from a race which eats badly cooked food, irritating to the digestive organs and unsatisfying to the appetite. Wholesome and palatable food is the first step in good morals, and is conducive to ability in business, skill in trade, and healthy tone in literature."

A Means to an End

It is quite true that we may put food in a wrong position, making it an end rather than a means in living. We should eat to live, not live to eat. Yet we must keep in mind that right food, clothing and shelter are the primary conditions of health, and that health is essential to the most complete happiness and to the highest usefulness.

Some one has said that "well dressed men and women, well fed men and women, are still an ethical possibility of the future." However this may be in regard to dress, certainly an age that has devoted so much time and thought to feeding on the stock farm, so much attention to the right nutriment for plants, and that has solved so many difficult problems in these directions, should be able to lay down the principles which govern the diet of human beings.

Importance of the Food Problem

While the food question then is by no means the one thing in housekeeping as it is apparently so often considered, it yet is of real and vital importance; and the housekeeper who desires to make the most of her

opportunities to contribute to the extent of her ability to the welfare of her family, should master the principles of diet so far as they are known, should keep an open mind toward new knowledge, and should apply with discretion and intelligence the knowledge now available in this direction.

THE COST OF FOOD

The first practical question that will appeal to the housekeeper in regard to food is its cost. Long before she asks what proportion of carbohydrate, of fat, and of proteid she must provide for her family, the question, "What shall I spend for food?" appeals to her, and indeed she is often forced by absolute necessity to decide the question. Later, "How shall I spend?" will be the important problem.

Proportion of Income for Food

Two main questions are involved. First, What proportion of the family income may go for food? What is the relation of the expenditure for food to that for rent, for clothing, for travel and amusement, for books and education? Second, What is the minimum cost per individual of food sufficient to give necessary nourishment? How much shall this minimum cost be exceeded for the sake of added attractiveness, increased digestibility, or adaptation to individual taste?

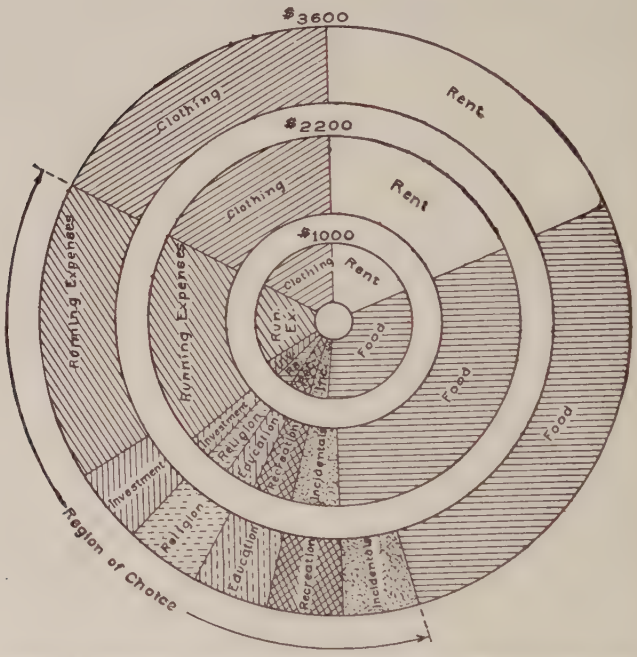
Raw Food Only Part of Cost

Nor is the cost of food a question of raw material alone. The amount of waste must be considered, the cost of the fuel used in cooking, and the cost of service. These often triple the original cost of the food.

Mr. Atkinson has said that half the cost of life is the price of food. This broad statement is true only in the case of the small income. A fairer interpretation of the matter is given by Dr. Engel, who has formulated four laws that in the main seem to hold, both in ideal and actual budgets. As quoted in *The*

DIVISION OF INCOME CHART

Typical Family of Two Adults and Three Children



Running Expenses include Wages, Fuel, Light, Ice, Etc. With $1,000 Income the Children Would be Educated in the Public Schools.

The above chart was adapted from a large colored chart prepared under the direction of Mrs. E. H. Richards for the Mary Lowell Stone Exhibit on Home Economics.

Cost of Living, the first of these laws is "that the proportion between expenditure and nutriment grows in geometric progression in an inverse ratio to well-being; in other words, the higher the income, the smaller is the percentage of the cost of subsistence." That is, while clothing, rent, heating and lighting keep a nearly invariable proportion, whatever the income, the proportion expended for food varies from sixty per cent in an income of three hundred dollars to twenty-five per cent or less in the three thousand dollar income.

Cost per Person per Day

In discussing the amount of money needed for food, it is usual to consider the amount expended for each individual per day. How much is necessary to supply the required nourishment depends upon various factors. The locality will be important. As a rule, country prices are lower than those in the city, while in different sections of the same city there may be wide variation. Eastern prices differ from those of the middle west, and these again from those prevalent in the far west or the south. In institutions where food is purchased in large amounts, the cost is less per person than in the individual household. An absolutely definite statement is, therefore, impossible, but a number of experiments have shown that a sufficient amount of the simplest raw food material may, under favorable circumstances, be furnished for from eight to ten cents a day per person. This implies the absolute exclusion of all but the cheapest materials. Fifteen cents for

each person means a less limited choice in raw materials, but the most careful management and the strict denial of anything approaching luxury. For twenty-five cents a day, one may add to the dietary a limited amount of fresh fruit and vegetables in season, coffee and other beverages, a fair supply of milk, and may furnish a satisfactory variety of food, while forty cents per person gives an excellent table with added luxuries, though it will not purchase fruit out of season, such as strawberries in January, nor give an unlimited supply of high priced game and similar delicacies.

Standards

In deciding what one of these standards to adopt, the number of members in the family and the total amount of income must be considered. The typical economic family, on which estimates are made, is one of five members, two adults and three children, or four adults. The real family often has six or eight members, and this additional number must modify the application of economic theories to real life.

True Food Economy

It is not desirable to cut down the expenditure for food to the lowest point at which nutritive food may be obtained if the income justifies a larger expenditure. *Economy does not mean spending a small amount, but expending money in such a way that it may bring in the largest return.*

Cost of Cooking

The cost of cooking modifies the expenditure for raw material. Often a cheap food, requiring long cooking, is in the end more expensive than a higher priced food requiring only a short cooking. This dif-

ference is particularly marked in the case of such a fuel as gas. With a coal stove careful planning for the utilization of all the heat may mean only the difference between the wasting of heat and the using of it. For example, the beans baking in the oven while ironing is going on add practically nothing to the amount of fuel used, while the beans baked in the gas oven must have the cost of the gas consumed added to their cost. It is quite possible that a cheap, tough piece of meat might consume so much gas in the long cooking necessary to stew it that its cost would be raised nearly to that of the more expensive cut that it supplanted.

Cost of Labor

Another element in the cost of food is that of the labor consumed in preparation and in service. The time taken to prepare a certain dish must be added to the cost of the raw materials before we can fairly estimate the cost of that dish. It must be remembered, however, that a dish requiring long cooking does not necessarily involve the expenditure of much time in preparation.

In a certain hotel having a large number of guests it was estimated that the extra time required to add a sprig of parsley to each plate of meat served meant the employment of an additional helper for the equivalent of one day a week. In the private family, the difference between a dinner served in three courses, or in four, means an expenditure of additional time that has a definite money value.

Waste of Food

The waste of food must also be considered. This is of two kinds, necessary waste, and needless waste. It is foolish to say, as some have done, that the garbage can might be eliminated from our houses if greater care were taken. The parings of potatoes, the husks of corn, the pods of peas, must always be refuse. In one experiment it was found that because of the cost of service, it was cheaper to allow thick parings of potatoes to be thrown away than to pay for the care that would insure thin parings. On the other hand, the head of a certain institution found that the careful paring of the potato meant the actual saving of a large number of bushels each year. Mrs. Richards says, "It is not food actually eaten that costs so excessively; it is that wasted by poor cooking, by excessive quantity and by purchase out of season when the price is out of all proportion to its value.

Amount Harmony Flavor

"Good judgment as to the amounts to be prepared, as to the harmony of the meal, the blend of flavor; as to the right appetizers; and good humor and cheerful conversation, with the most attractive setting and perfect serving, will cut down the cost of almost any table one-half. Many seem to hold the idea that hospitality requires the setting of a double portion before the guests, and this alone doubles the cost of food in some families."

She says again, "In no other department of household expenditure is there so great an opportunity for the exercise of knowledge and skill with so good re-

sults for pocket and health; no item of expense is so fully under individual control."

Economical Cookery

On the other hand, Thudicum, in his *Spirit of Cookery*, refers to "the delusion of economical cookery with scraps costing nothing." He speaks of what is termed "the fearful waste in English kitchens," and says, "When we proceed to investigate the items of the alleged waste, we find them to consist of stale lumps of bread, bacon rind, and bare bones of boiled or roast joints." He quotes with scorn and denial a prominent medical journal which says, "The French cook makes excellent and nutritious soup out of materials which the English housewife throws away as useless; while her pot-au-feu is composed of stray scraps carefully husbanded, which cost her nothing, but which, when skilfully combined, constitute a useful and inexpensive food."

True Cost

Perhaps the truth lies between the two extrêmes. To set an attractive table costs something in raw food material, in equipment and in service. The snowy table cloth, always spotless, so often suggested in newspaper articles as a substitute for expensive food, means the expenditure of time, money and energy. The soup made from "scraps" involves expenditure of time and fuel, if not of money with which to purchase fresh material. The cost of saving may outweigh the cost of material saved. But that there is much unnecessary waste in the average household can not be denied. Nor is the mere money value of the

material wasted the most serious part. The habits of carelessness and extravagance engendered show themselves in a lack of responsibility for material and indifference toward useless expenditure of time and energy as well as money, and in general thoughtlessness.

Conditions Alter Cases

How the money to be expended shall be distributed between different food materials must be largely a matter for the individual housekeeper since conditions vary so greatly. As a rule, vegetable foods are cheaper than animal. This may be counter-balanced by the more easy digestibility of the animal food, as we shall see in a later discussion. Whether one food or another is the cheaper source of a particular food principle depends upon the percentage composition and comparative cost of these foods. As is seen in Table I, potatoes at two cents per pound, i. e., 30 cents per peck, cost almost twice as much, so far as actual food value is concerned, as rice at five cents per pound. When rice is ten cents per pound, as it is in many places at present, and potatoes are one cent a pound, conditions are reversed. Sweet potatoes at five cents a pound must be definitely considered as a luxury when white potatoes may be had for one cent at the same place.

TABLE 1

Some Important Foods Considered as to Their Nutritive and Economic Values.

	Refuse, per cent.	Water, per cent.	Proteid, per cent.	Fat, per cent.	Carbohydrates, per cent.	Calories, per lb.
Nuts (peanuts, edible portion)	.....	9.2	25.8	38.6	24.4	2560
Sugar (granulated)	.....	.....	.....	.....	100	1857
Cornmeal (bolted)	.....	12.9	8.9	2.2	75.1	1655
Wheat flour (roller process)	.....	12.5	11.3	1.1	74 6	1645
Rye flour	.....	12.7	7.1	.9	78.5	1630
Rice	.....	12.4	7.8	.4	79	1630
Legumes (dried)	.....	13.2	22.3	1.8	59.1	1590
Meats (as purchased about)	12	55	16	1.5	.....	928
Fish (fresh)	30	45	12	4	.....	388
Potatoes	15	67.1	1.8	.1	15.3	325
Milk	.....	87	3.3	4	5	325
Bananas	40	44.5	.7	.5	13.7	290
Fruit (apples, grapes, etc.)	25	60	1	.9	12.9	285

Wheat flour at	2	cents	per	pound	furnishes	3000	calories	for	3.6	cents.
Cornmeal at	3	"	"	"	"	"	"	"	5.4	"
Wheat flour at	4	"	"	"	"	"	"	"	7.2	"
Rice at	5	"	"	"	"	"	"	"	9.2	"
Potatoes at	1	"	"	"	"	"	"	"	9	"
Legumes at	8	"	"	"	"	"	"	"	15	"
Milk at	2	"	"	"	"	"	"	"	18	"
Potatoes at	2	"	"	"	"	"	"	"	18	"
Nuts (kernels) at	16	cents	"	"	"	"	"	"	19	"
Cheese (American pale) at	14	"	"	"	"	"	"	"	20	"
Fruit at 2 cents per pound					"	"	"	"	21	"
Milk at 3½ (7 cents a qt.)					"	"	"	"	32	"
Beef (medium fat) at 15 cents (15% bone)					"	"	"	"	47	"
Beef (sirloin) at 25 cents per pound					"	"	"	"	69	"
Eggs at 25 cents per dozen					"	"	"	"	115	"

(From *The Cost of Food*, by Mrs. Ellen H. Richards.)

Finding the Cost of Food

The most satisfactory way to get at the cost of food per individual in a family is to keep careful accounts over a considerable period of time, both of the actual expenditure for food, and of the number of meals served. To make an experiment for a definite time, one month for instance, look over the material on hand, estimating as accurately as possible the amounts of flour, of sugar, of spices, etc. At the end of the month, again take account of stock and estimate the value of the materials on hand. Add the difference if there is less, and subtract the difference if there is more, to the amount expended during the month, and the result will be the cost of the food.

The following tables are records of actual expenditure for food. Table II gives the expenditure in two institutions in an eastern city, where, under the direction of an expert, effort was made to provide a sufficient amount of food at the lowest price.

The left-hand table gives the expenditure for food in a house of correction and the right-hand table for that in an orphans' home. In this table it will be noticed that one of the largest expenditures was for milk. The cost for food at the officers' table was about the same in both institutions. Provisions were bought at wholesale prices.

TABLE II

Average Daily Cost of Food Materials per Person in Two Public Institutions in Boston.

	Inmates	Officers	Inmates	Officers
Number of Persons Fed	523	73	333	35
	Cents	Cents	Cents	Cents
Meat and fish (fresh or salt)	4.67	28.13	1.59	19.60
Eggs		1.14		1.29
Cheese		0.26	0.16	0.20
Milk	0.93	3.13	3.75	5.02
Butter and Lard		3.16	0.07	2.97
Flour, cornmeal, crackers	2.22	0.75	1.88	1.19
Oatmeal, hominy, rice	0.46	0.12	0.27	0.35
Peas, Beans	0.26	0.04	0.12	0.11
Tapioca, sago, cornstarch		0.04	0.04	0.08
Sugar	0.62	0.67	0.29	1.27
Dried fruits		0.06		0.24
Potatoes	0.38	0.57	0.17	0.53
Fresh vegetables	0.26	0.48		0.38
Apples	0.02	0.26		0.11
Molasses	0.04	0.04	0.03	0.06
Cost per day per person	9.86	33.85	8.37	33.40

(From Report of Institutions Commissioner of the City of Boston for 1897.)

Experience of College Girls

Table III is a record from the middle west, and is taken directly from the expense account of three college girls who were trying to keep the cost of living as low as possible. There is no pretense to an ideal diet. Probably it was low in proteid, but the girls lived and apparently thrived upon it.

TABLE III

Weekly Expense Account for Food for Three People.

Second Week in October, 1903.		*Third Week in October, 1903.*	
Navy Beans	.25	Bread	.05
Sardines	.05	Grapes	.35
Butterine	.20	Bananas	.15
Meal, corn	.20	Raisins	.10
Apples	.20	Crackers	.10
Bananas	.10	Bread	.10
Bread	.10	Cheese	.20
Flour	.10	Meat	.13
Crackers	.10	Milk	.51
Potatoes	.25	Meat	.15
Beef	.40	Cranberries	.10
Salt pork	.07	Cranberries	.10
Bread	.20	Crackers	.10
Butter	.13	Oleo	.20
Butter	.20	Pork	.05
Prunes	.05	Bread	.10
Celery	.05	Salt	.10
Milk	.51		
	$3.16		$2.59

Second Week in April, 1904.		*Third Week in April, 1904.*	
Bread	.15	Soda crackers	.10
Pork, fat	.05	Crackers	.10
Radishes	.05	Can Tomatoes	.10
Cookies	.15	Ham	.15
Grapes	.20	Bread	.05
Crackers	.10	Oranges	.20
Bread	.05	Beans	.05
Honey	.12	Crackers	.10
Beefsteak	.10	Eggs	.18
Crackers	.20	Flour	.10
Bananas	.08	Bread	.05
Oranges	.10	Apple butter	.10
Lettuce	.05	Nuts	.03
Beef, boil	.30	Macaroni	.15
Potatoes	.40	Sugar	.25
Bread	.05	Blackberries	.20
Strawberries	.10	Beans	.05
Bread	.05	Pork steak	.10
Milk	.51	Pickles	.10
Apple butter	.10	Hamburg steak	.15
		Butter	.25
		Milk	.51
	$2.91		$3.07

Total cost for three people for twenty-eight days	$11.83
Average cost for one person for one day	0.141

Liberal Table with High Prices

Table IV shows the expenditure in a summer home in the mountains. In this case no effort was made to reduce expense by excluding articles desired, but true economy was practiced in careful planning of meals and in utilizing all material.

TABLE IV

Expenditure During the Summer of 1903, in a Mountain Town in New England, Some Miles from a Railroad.

	Lbs.	Proteid	Fat	Carbohyd'te
Fish	44.5	5.9345	2.057	.....
Meats	83.88	24.259	25.9495	.....
Soups	4.	.088	.022	.....
Dried Fruit	3.5	.0805	.1065	2.6735
Dairy	343.1	13.616	49.681	14.354
Cereals	28.	2.3775	.3615	19.099
Bakeries	16.	1.352	1.327	10.597
Sugar and starches	151.16	11.680	3.719	116.717
Fruit	87.	.564	.303	11.349
Vegetables	250.5	8.915	3.775	36.06
293 Days (1 person)	1011.64	68.866	87.444	210.8495
Each day per pers'n	3.45 lbs.	106.5 grams 3.76 oz.	135.17 grams 4.78 oz.	326.1 grams 11.51 oz.

Total cost, $114.14. Cost per day, per person, $0.39.

The number of meals served was 878. This is taken as equivalent to 293 days for one person.

The prices of some of the chief articles of food are given here.

Beef roast	20 cents per pound	Salmon	30 cents per pound
Beef steak	28 " " "	Haddock	6 " " "
Lamb roast	18 " " "	Potatoes	20 and 25 cents per peck
Lamb chops	25 " " "	Cream	25 cents per quart
Veal "	20 " " "	Milk	5 " " "
Chicken	25 " " "	Butter	28 " " pound
Fowl	20 " " "	Eggs	28 and 30 cents per dozen
Halibut	16 " " "		

The following tables give in detail the weight and composition of the various food used.

Fish

	Lbs.	Prot.	Fat	Carb.
Mackerel	12½	1.275	.525	.....
Salmon	4	.612	.356	.....
Halibut	6	.918	.264	
Haddock	8¼	.693	.0165	
Dressed Cod	2	.222	.004	
Lobster	1½	.0835	.005	
Blue fish	2¼	.225	.0135	
Cod (salt)	3	.762	.009	
Herring	2	.224	.078	
Sardines	4	.92	.788	
	44.5	5.9345	2.057	.....

Meats

	Lbs.	Prot.	Fat	Carb.
Steak	14¼	3.405	1.4535	
Lamb	12¾	7.006	9.799	
Veal	4¾	.954	.357	
Chicken	13⅞	2.984	.346	
Pork (salt)	1½	.106	1.002	
Ham	14¾	2.978	3.304	
Fowl	2½	.482	.407	
Bacon	4½	4.095	2.6685	
Lard	5		5.000	
Sl. Ham	1	.192	.162	
Pot. Ham	1	.095	.1705	
Chicken	1	.128	.014	
Corn beef	4	1.052	.748	
Dried beef	1	.392	.054	
Tongue, Ox	2	.390	.464	
	83.88	24.259	25.9495	

Soup

	Lbs.	Prot.	Fat	Carb.
Julienne	1	.027		.....
Tomato	2	.036	.022	.....
Corn	1	.025		
	4	.088	.022	

Dried Fruit

	Lbs.	Prot.	Fat	Carb.
Seed raisins	3	.078	.099	2.283
Citron	½	.0025	.0075	.3905
	3½	.0805	.1065	2.6735

Dairy

	Lbs.	Prot.	Fat	Carb.
Eggs	27.6	3.643	3.312	.....
120 qts. milk	240.	7.920	9.60	12.00
19¼ qts. cream	38.5	.962	7.022	1.732
Cheese	3.	.751	.847	.622
Butter	34.	.34	28.9	
	343.1	13.616	49.681	14.354

Cereals

	Lbs.	Prot.	Fat	Carb.
Rice	4½	.126	.004½	1.098
Wheat	4	.484	.072	3.008
Sh. Wheat	1	.105	.014	.779
Farina	1	.11	.014	.763
Corn Meal	12	1.104	.228	9.048
Hominy	3½	.290½	.021	2.765
Rice Fl.	2	.158	.008	1.638
	28	2.377½	.361½	19.099

Bakeries

	Lbs.	Prot.	Fat	Carb.
U. Biscuits	2	.196	.182	1.462
Bread	6	.486	.414	3.252
Gin. Snaps	2	.130	.172	1.52
Van. Cr.	1	.066	.140	.716
Mis. Cookies	2	.134	.192	1.448
Water Cr.	2	.234	.10	1.514
Saltines	1	.106	.127	.685
	16	1.352	1.327	10.597

Sugars and Starches

	Lbs.	Prot.	Fat	Carb.
2 qts. Molasses	6	.144		4.158
Sugar	40			40.
1 gal. Syrup	8			11.016
Maccaroni	1	.402	.027	2.223
S. D. Flour	70	7.70	.63	42.08
F. M. Flour	15	2.07	.285	10.785
Rye Flour	3	.204	.027	2.361
Spaghetti	2	.242	.008	1.526
Honey	2	.008	.....	1.624
Chocolate	2½	.322	1.217	.657
Almonds	1⅔	.588	1.525	.287
	151⅙	11.680	3.719	116.717

Fruit

	Lbs.	Prot.	Fat	Carb.
Oranges	3	.024	.006	.348
Lemons	6	.06	.024	.510
Currants	1	.015	.....	.128
Raspberries	1	.017	.01	.126
Melons (12)	12	.036	.....	.552
5 doz. peaches	7	.05	.....	.03
Apples	25	.100	.125	3.550
Plums	2	.02	.....	.402
Bananas	1½	.019	.009	.55
Box berries	1	.017	.01	.126
Grapes	5	.065	.08	.960
3 pears	½	.003	.002	.071
2 pineapples	4	.016	.012	.388
3 canteloupes	3	.009		.138
Canned peaches	4	.028	.004	.432
Pears	1	.003	.003	.180
Cherries	4	.044	.004	.844
Qr. Mar	2	.012	.002	1.690
Quince	2	.014	.002	.216
Currants	2	.012	.012	.108
	87	.564	.305	11.349

Vegetables

	Lbs.	Prot.	Fat	Carb.
Sweet Pot.	31	.93	.656	13.051
Beets	30	.480	.03	2.910
Potatoes	82½	2.062	.26	5.430
Peas	29	2.03	1.18	4.901
Beans	5	.115	.15	.370
Squashes	2	.028	.01	.180
Cabbage	10	.160	.30	.560
Tomatoes	20	.18	.08	.780
Carrots	3	.022	.008	.186
Olives	1	.008	.202	.08
Mushrooms	2	.07	.008	.136
Baked beans	20	1.38	.800	3.920
Asparagus Tips	10	.210	.330	.220
Corn	1	.031	.011	.197
Split Peas	4	.984	.04	2.480
Dried beans	1	.225	.015	.659
	250.5	8.915	4.08	36.060

A Typical Investigation

As an example of fairly attractive menus with low priced foods, the following extract from Bulletin No. 129 of the Office of Experiment Station, U. S. Department of Agriculture, by Miss Bertha M. Terrill, may be of interest:

"In February, 1902, the students of the Bible Normal College, situated then in Springfield, Mass., voted to save a sum of money, which they desired to raise for a special object, by reducing the cost of their table board. They had been paying $3 per week for table board at the time, or very nearly 43 cents per person per day, which of course included the cost of fuel, preparation, and service, estimated to be 10.6 cents per person per day. Learning that it has been found possible to provide a balanced and nourishing diet for 10 cents per man per day for the raw food, they entered eagerly into an experiment with a diet to cost that amount for food materials only, the cost of prep-

aration, etc., to remain the same as before, making the total cost of the daily food as served 20.6 cents per person, or 22.4 cents less than their ordinary diet. There were 30 students interested in this project, and it was planned to continue the investigation three days, as this would suffice to save the $20 desired." * *

The menus for the different days covered by the study were as follows:

SATURDAY, FEBRUARY 8.

Breakfast.—Oatmeal and top of milk, fish cakes, toast (with a little butter), prunes, milk and cereal coffee.

Dinner.—Beef soup, croutons, beans (baked with pork), brown bread, apricot shortcake.

Supper.—Sandwiches (cheese and jelly), white and graham bread (no butter), sliced bananas, milk.

SUNDAY, FEBRUARY 9.

Breakfast.—Corn-meal mush and top of milk, baked beans, buns, milk and cereal coffee.

Dinner.—Split-pea soup and crackers (crisped), potted beef, brown sauce, baked potatoes, bread, rice with milk and sugar.

Supper.—Brown-bread sandwiches (with a little butter), white-bread sandwiches with date and peanut filling without butter, cocoa, popcorn salted.

MONDAY, FEBRUARY 10.

Breakfast.—Oatmeal with top of milk, cream toast, cereal coffee.

Dinner.—Baked-bean soup, crisp crackers, Hamburg steak balls, brown sauce, hominy, turnip, peanuts and dates.

Supper.—Potato and beet salad, gingerbread, cheese, bread, milk.

TUESDAY, FEBRUARY 11.

Breakfast.—Wheat breakfast food and dates, creamed codfish muffins (with little butter), milk and cereal coffee.

Dinner.—Beef Stew with biscuits, bread pudding, bread.

Supper.—Scalloped meat and potato, bread (with butter), prunes chocolate candy "fudge."

WEDNESDAY, FEBRUARY 12.

Breakfast.—Oatmeal with top of milk, hash, corn cake, milk and cereal coffee.

Dinner.—Vegetable soup, croutons, baked stuffed beef's heart, brown sauce, rice, cornstarch blanc mange, caramel sauce.

Supper.—Potato and celery salad, white and graham bread, fried corn-meal mush, sirup,

THURSDAY, FEBRUARY 13.

Breakfast.—Corn-meal mush with top of milk, hashed meat on toast, milk and cereal coffee.

Dinner.—Salt salmon, drawn butter sauce, baked potatoes, parsnips, bread, evaporated apple shortcake.

Supper.—Cold sliced beef's heart, creamed potatoes, cocoa, bread (white and graham), ginger snaps.

The Family

"The family in this experiment consisted of 30 students—26 women and 4 men—ranging in age from 25 to 45 years. Considering the 4 men as equivalent to 5 women as regards food consumption, the family for six days was equivalent to 186 women for one day.

Cost of Food

"The cost of the diet, 9.4 cents per woman per day, was just within the limit set, but the quantities of nutrients and energy (75 grams of protein and 2,243 calories) were somewhat smaller than was intended.

"The low cost of the diet in this experiment was made possible by the selection of simple and inexpensive food materials and by reducing the quantities of some foods commonly used rather abundantly, as meat and butter. Most of the students felt quite satisfied with the food. The curtailing of the amount of butter served at the table was considered the greatest deprivation; a small pat, about half the customary size, being served to each where butter is indicated with bread on the menu.

Economy and Nourishment

"The importance from the standpoint of economy of selecting foods which are nourishing rather than those having a low food value but which please the palate and add to the attractiveness of the diet, is illustrated by a dietary study made of a family in New Jersey in which it was found that $2.16 was expended in three weeks for oranges and $3 for celery, making a total of $5.16 for these two articles, which together furnished only 150 grams of protein and 6,445 calories of energy. During the same period $5.16 was also expended for cereal foods and sugars, which supplied 3,375 grams of protein and 184,185 calories of energy, or about twenty-five times the amount furnished by the oranges and celery. Of course, the sum expended for these articles was not excessive and they undoubtedly helped to make the diet palatable and pleasing, a by no means unimportant consideration, but it is evident that they were not economical sources of nutritive material.

Dainty Serving

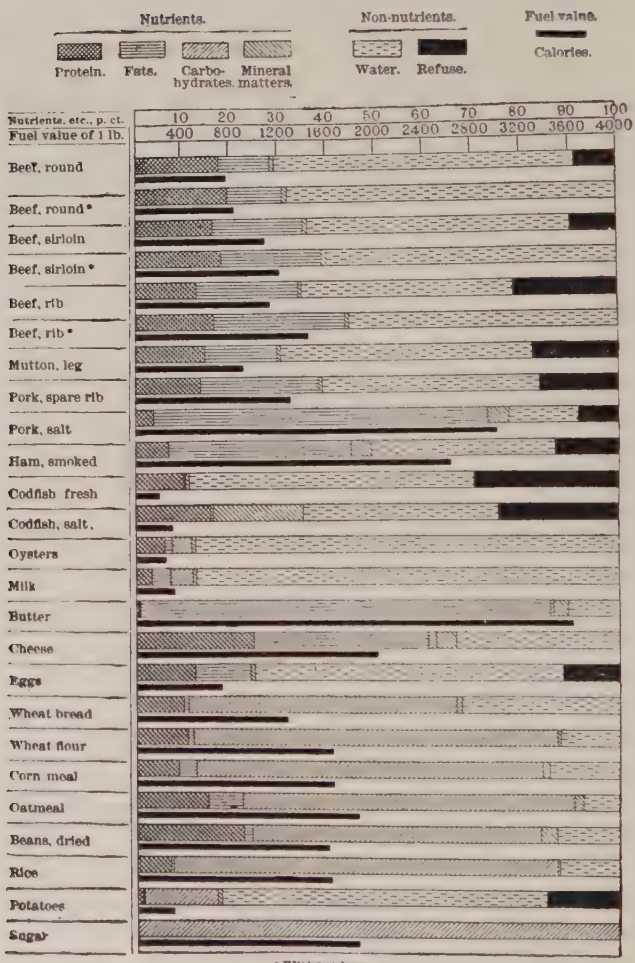
"In the present investigation it was found to be well worth while to use special care in arranging the dishes for serving, that they might be as appetizing in appearance as possible. Much care was also observed in avoiding waste both by careful preparation and by the use of all 'left overs.'"

In the following table is given the details of cost, weight and nutritive value of the food used in this investigation.

Weights and Cost of Food and Nutrients

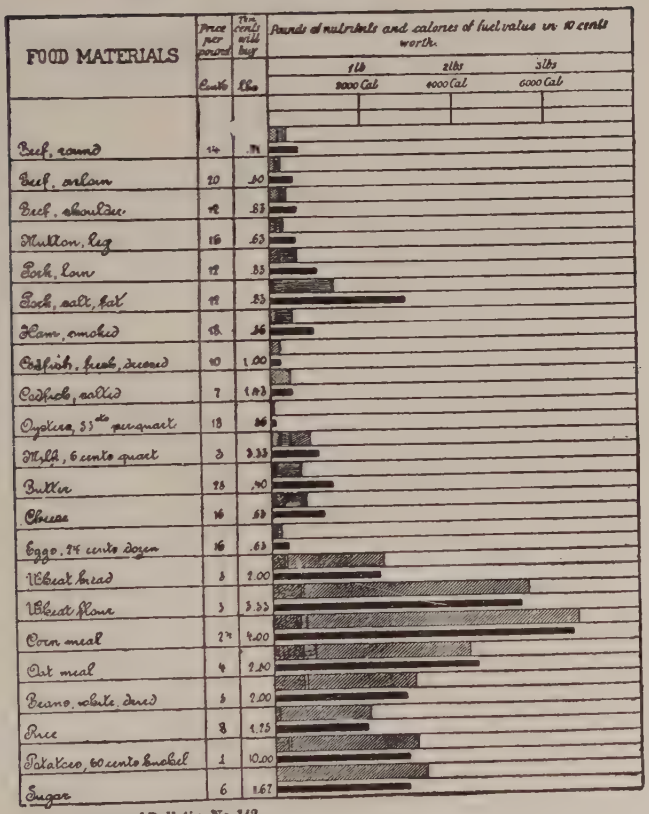
Food consumed during the entire study (6 days).	Cost. nutrients, and fuel value per woman per day.					
Kinds and amounts.	Cost.	Cost.	Protein.	Fat.	Carbohydrates.	Fuel value.
ANIMAL FOOD.	*Dols.*	*Cts.*	*Gms.*	*Gms.*	*Gms.*	*Calories.*
Beef: Hearts, 11 lb., 38c.; round, 10.5 lb., $1.05; rump, 10 lb., 80c.; shank, fore, 3 lb.; brisket (stew), 7.25 lb., 50c	2.73	1.5	15	19	.....	229
Pork: Bacon, 2 lb., 30c.; salt pork, 2 lb., 18c.; lard, 1 lb., 12c.	.60	.3	1	8	.....	75
Fish: Cod, salt, 4 lb., 42c.; salmon, salt, 5 lb., 40c	.82	.4	5	2	.....	38
Eggs, 1 lb., 33c	.33	.2	.....	.....	.....	.....
Butter, 9 lb., $2.25	2.25	1.2	.....	19	.....	169
Cheese, 2 lb., 30c	.30	.2	1	2	.....	22
Milk, 210 lb., $2.70	2.70	1.4	17	29	26	350
Total animal food	9.73	5.2	39	70	26	883
VEGETABLE FOOD.						
Cereals: Corn meal, 10 lb., 29c.; pop corn, 1 lb., 5c.; hominy, 1.44 lb., 5c.; oatmeal, 4.5 lb., 15c.; rice, 4 lb., 28c.; graham flour, 10 lb., 25c.; white flour, 66 lb., $1.55; crackers, Boston, 0.75 lb., 4c	2.66	1.4	27	4	178	8[illegible]
Sugars, starches, etc.: Sugar, granulated, 20 lb., $1; molasses, 2.33 lb., 36c.; cornstarch, 0.33 lb., 2c.; cocoa, 1 lb., 17c.; chocolate, 0.12 lb., 5c.	1.60	.9	1	1	54	22[illegible]
Vegetables: Beans, lima, 2 lb., 18c.; beans, pea, 2.44 lb., 10c.; beets, 1.25 lb., 4c.; cabbage, 5 lb., 10c.; carrots, 1.25 lb., 2c.; celery, 2.06 lb., 10c.; parsnips, 4.69 lb., 15c.; peas, split, 1.69 lb., 13c.; potatoes, 80 lb., $1.47; turnips, 5.5 lb., 7c.	2.36	1.3	7	1	41	201
Fruits, nuts, etc.: Apricots, 1.5 lb., 17c.; bananas, 7 lb., 30c.; dates, 2 lb., 12c.; prunes, 2 lb., 18c.; raisins, 0.25 lb., 2c.; peanuts, 2 lb., 25c.; crab-apple jelly, 0.2 lb., 3c.	1.07	.6	1	2	13	74
Total vegetable food	7.69	4.2	36	8	286	1,360
Total food	17.42	9.4	75	78	312	2,243

Chart of Composition of Foods



* Without bone

Chart of Pecuniary Economy of Food


Protein.
Fats
Carbohydrates
Fuel Value
FOOD MATERIALS
Price per pound
Ten cents will buy
Pounds of nutrients and calories of fuel value in 10 cents worth.
1lb 2000 Cal
2lbs 4000 Cal
3lbs 6000 Cal
Beef, round 14 .71
Beef, sirloin 20 .50
Beef, shoulder 12 .83
Mutton, leg 16 .63
Pork, loin 12 .83
Pork, salt, fat 11 .83
Ham, smoked 18 .56
Codfish, fresh, dressed 10 1.00
Codfish, salted 7 1.43
Oysters, 35 to per quart 18 .56
Milk, 6 cents a quart 3 3.33
Butter 28 .80
Cheese 16 .63
Eggs, 24 cents a dozen 16 .63
Wheat bread 5 2.00
Wheat flour 3 3.33
Corn meal 2½ 4.00
Oat meal 4 2.50
Beans, white, dried 5 2.00
Rice 8 1.25
Potatoes, 60 cents a bushel 1 10.00
Sugar 6 1.67

From Farmers' Bulletin, No. 142.

FOOD AND THE BODY

Composition

It is impossible to decide intelligently how the money available for food shall be distributed among different food materials without understanding something of the composition of these food materials, and of the relation of food to the needs of the body. Experience has taught us many things, but the accumulation of experience needs interpretation by definite scientific knowledge. Until lately this knowledge was in the hands of only a few, and even then in so indefinite a form that it was not available for the housekeeper, no matter how well trained, and hardly for an educated physician.

Much progress has been made, but even to-day the housekeeper is often a little slow in availing herself of the knowledge she needs. This is partly because of the common feeling that what our fathers and mothers knew is enough for us, and partly because so much of the information is still locked up in more or less technical books, and the ordinary housekeeper, even though she be well educated, has not the key. It is to furnish the key to some of this knowledge that this series of lessons is written.

Function of Food

We all know in a general way that food nourishes us and makes us strong. But when we try to interpret this general idea into specific terms we find that we do not realize its meaning. Nothing is in the strict sense a food unless it performs at least one of three

functions, (1) that of building the body, (2) furnishing heat, and (3) giving power to work.

Building Foods

The first function of food, that of building the body, is exercised not only in the growing child, where the material that can be transformed into bones and muscles, blood and nerve tissue, must be furnished by food, but in the adult, since even after growth has ceased, the constant waste of the body tissue must be repaired by food. So far as this function is concerned, the composition of the body must determine to a great extent the kind of material that may be used as food. It is easy to see that the body can be built only by foods containing the same elements, and that the proportion of these elements must bear some relation to their proportion in the body. It is reasonable to expect that the elements are combined in food in a way similar to that in which they are combined in the body

Composition of the Body

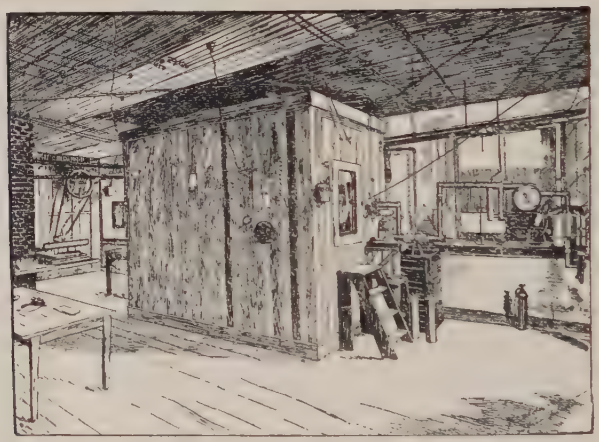
The body of a man of average weight has been estimated to contain the following amounts of the various combinations known as the proximate principles:

Water	108 lbs.
Mineral matter	11.00
Proteid	29.75
Fat	5.00
Carbohydrates	.25
Total	154.00

It will be judged from this that so far as the organic food principles proteid, carbohydrate and fat are concerned, proteid holds the chief place as a tissue former.

Fuel and Energy Foods

Not only must the body have its actual material furnished by the food, but from this also must be derived its energy.



ATWATER'S RESPIRATION CALORIMETER.

A Man Lives in the "Box" for Days and the Actual Heat and Energy Obtained from the Food Consumed is Determined. (See page 52.)

The two forms of energy with which we are especially concerned in our study of the body are heat and power to work.

Heat

Heat is required to maintain the body temperature necessary in order that the processes of life may be carried on

Work

The work performed may be considered as of two kinds, internal and external. The internal work is that used in maintaining the different functions of

the body itself. The beating of the heart, breathing, the absorption of food, all require the expenditure of energy; this internal work requires a large portion of the available power. As in all machines, energy is lost in the form of radiant heat, but the body is considered an efficient machine because a larger proportion of energy is available for external work than in most engines constructed by man.

External Work Variable

The amount of energy required for external work, i. e., muscular work, is a variable factor, and the amount of physical activity is consequently important in determining the amount of food necessary.

Source of Energy

So far as present knowledge goes, we may say that the energy of the body is derived from the slow oxidation (or combustion) of food that takes place in the tissues all over the body. The process is undoubtedly a complex one, far from the simple chemical union of the food materials with the air we breathe. It is easy to understand that this oxidation gives heat, but how it produces the power of muscular contraction, nervous energy, and all the activities of life is not known.

Potential Energy

All combustible substances have what is known as potential energy. This might be defined as stored-up energy. It implies that energy from some exterior source has been used in producing the substance in its present form. For instance, heat from the sun has been utilized in the formation of the starch or proteid in the plant, and this energy is again set free in the oxidation or the decomposition of the substance.

Potential energy may perhaps be most easily understood by thinking of one form of it, energy of position. A weight lifted to a height has by virtue of its place a certain amount of *potential energy*. The fall of the weight from its position will convert its potential energy into active or *kinetic energy* by which work is accomplished.

The waste materials of the body have little or no potential energy, and the outgo of the body differs in this important respect from its income. If the food taken in is only partially oxidized, the waste material still contains some energy, and this potential energy must be substracted from that of the income in order to find the amount available for the use of the body.

Unit of Heat and Energy

The value of a food to produce heat and mechanical energy is measured by the amount of heat that may be produced by it, and the unit of measure is the calorie. A calorie is the amount of heat required to raise about one pound of water four degrees Fahrenheit, or, accurately, the amount of heat required to raise one kilogram of water one degree centigrade. This is the large calorie, and it is sometimes written with a capital *C* to distinguish it from the small calorie. The small calorie has a value one-thousandth as great. The term used in this paper means the large calorie.

It has been found that there is an exact quantitative relation between heat and work, expressed by the term *mechanical equivalent of heat*. Experiments have shown that about 778 foot-pounds of work are con-

Mechanical Equivalent of Heat

sumed in heating one pound of water one degree Fahrenheit, or 1400 foot-pounds in heating the same amount of water one degree Centigrade. In other words, the same amount of energy would be expended in heating a pound (about one pint) of water one degree Fahrenheit, as in raising a weight of 778 pounds one foot, or a weight of one pound 778 feet. By the same calculations a calorie is equivalent to 3,087 foot-pounds. The calorie then is used as a convenient measure *not only of quantity of heat, but of mechanical energy, or power to work.*

The "Bomb" of a Bomb Calorimeter.

One gram of proteid has been found to yield 4.1 calories; a gram of carbohydrate yields the same amount, while a gram of fat yields 9.3 calories. Or more than twice as much heat can be obtained from a given amount of fat as from the same amount of either proteid or carbohydrate.

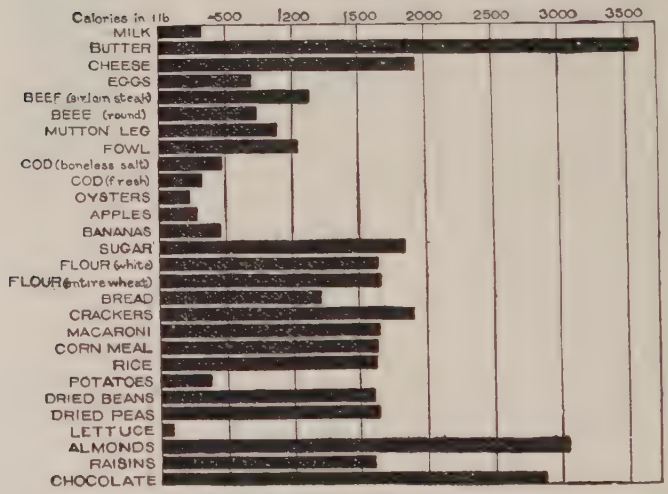
Bomb Calorimeter

The number of calories any particular food will yield theoretically is determined by the use of the bomb calorimeter. A portion of food of a given weight is enclosed in an iron shell or "bomb," which is then immersed in a given amount of water and the temperature of the water taken. By means of an electric spark the contents of the bomb are ignited and burned, and the temperature of the water is again taken at the end of the combustion. For instance,

if the burning of one gram of meat raised the temperature of one kilogram (about two pounds) of water seven degrees Centigrade, that amount of meat would be said to yield seven calories.

CHART OF HEAT AND ENERGY

Values in Calories of some Common Foods



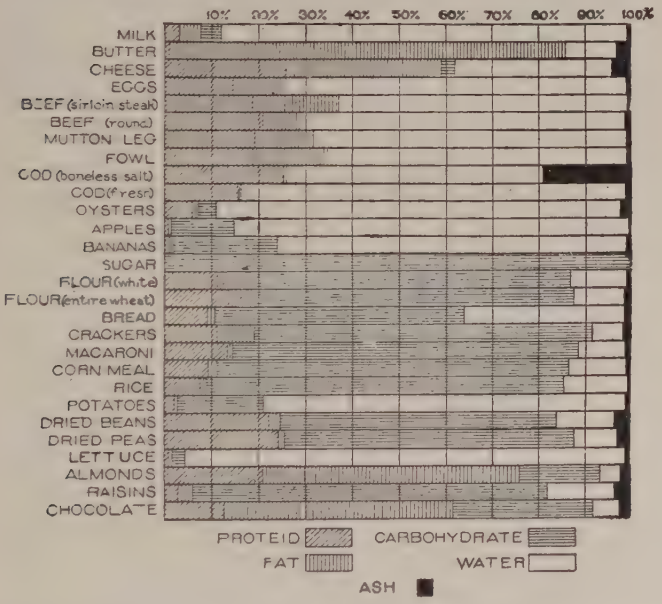
The chart given shows the number of calories yielded by several different foods.

Digestibility

There is one factor that is often not sufficiently considered in determining the amount of energy ob-

tainable from food. A food may yield excellent results in the calorimeter and yet be of little service in the body because of its lack of digestibility. It is

CHART OF COMPOSITION OF FOODS
Percentage of Nutrients of Edible Portion, i. e., Without Bone, etc.



by no means the food we eat but the food we *assimilate* that nourishes us. The portion of food that is really absorbed by the body differs greatly under different conditions and with different food materials. Many

careful experiments have been made of late, and more will be made to determine the amount assimilated in different cases. This element of digestibility is frequently not taken into account, and the value of a food is estimated wholly from its chemical composition.

Some reasons for this are the great difficulty in determining the digestibility of a food, the fact that this digestibility may vary from time to time according to the condition of the body, and the fact that the personal equation enters largely into the matter.

Digestibility of Food

The accompanying tables showing the comparative digestibility of some common foods are therefore merely a general statement, and represent average results.

Table of Digestibility and Fuel Value per Pound of Nutrients in Different Groups of Food Materials. (Atwater.)

Kind of food.	Protein.		Fat.		Carbohydr'ts	
	Digestibility.	Fuel value per pound	Digestibility	Fuel value per pound	Digestibility.	Fuel value per pound.
	Per cent.	Calories.	Per cent.	Calories.	Per cent.	Calories.
Meats and fish	97	1,940	95	4,040	98	1,730
Eggs	97	1,980	95	4,090	98	1,730
Dairy products	97	1,940	95	3,990	98	1,730
Animal food (of mixed diet)	97	1,940	95	4,050	98	1,730
Cereals	85	1,750	90	3,800	98	1,860
Legumes (dried)	78	1,570	90	3,800	97	1,840
Sugars	.....	.....	.....	.....	98	1,750
Starches	.....	.....	.....	.....	98	1,860
Vegetables	83	1,410	90	3,800	95	1,800
Fruits	85	1,520	90	3,800	90	1,630
Vegetable foods (of mix'd diet)	84	1,840	90	3,800	97	1,820
Total food (of mixed diet)	92	1,820	95	4,050	97	1,820

Table of Comparative Digestibility, Commencing with the Most Digestible and Ending with the Least Digestible of Meats and Other Common Animal Food.

Oysters.	Tripe, brains, liver.
Soft-cooked eggs.	Roast lamb.
Sweetbread.	Chops, mutton or lamb
White fish, boiled or broiled, such as bluefish, shad, red snapper, weakfish, smelt.	Corned beef.
	Veal.
	Ham.
Chicken, boiled or broiled.	Duck, snipe, venison, rabbit, and other game.
Leanroast beef or beefsteak.	Salmon, mackerel, herring.
Eggs, scrambled, omelette.	Roast goose.
Mutton, roasted or boiled.	Lobsters and crabs.
Squab, partridge.	Pork.
Bacon.	Smoked, dried, or pickled fish and meats in general.
Roast fowl, chicken, capon, turkey.	

(*From W. Gilman Thompson.*)

Fuel Value in the Body

It should be noticed that the fuel value obtained *in the body* from the various classes of foods is somewhat less than the theoretical amount mentioned on page 35, because they are not completely digested and assimilated nor completely oxidized in the body. The following values are used in the U. S. Government reports as representing average conditions:

Proteid, fuel value, 4 calories per gram, or 1,820 calories per pound.
Fats, fuel value, 8.9 calories per gram, or 4,040 calories per pound.
Carbohydrates, fuel value, 4 calories per gram, or 1,820 calories per pound.

Fuel and Energy Foods

The foods that are particularly useful in furnishing heat and energy for the body, the carbohydrates and fats, are frequently called the fuel foods, although proteid can act as fuel just as readily as can these. Since the proteids, however, have a more important function and are most expensive, the other foods are used as *proteid sparers*. The amount of these fuel foods that is to be taken depends not upon the amounts

present in the body, but upon the amount of heat and energy to be produced. This depends, in general, on the size of the body and the amount of muscular activity.

The Body and An Engine

The comparison is frequently made between the body and a locomotive, the food representing the fuel, the air taken in through the lungs representing the draft, the waste matters of the body corresponding to the smoke and ashes from the engine fire. In many ways this is a helpful comparison, but we need to keep in mind the essential differences between the human body and the mechanical engine as well as their likeness. Combustion in the body is much slower than in the machine, and is therefore not accompanied by light, though by the oxidation of the same amount of fuel the same total amount of heat is produced.

Oxidation in the body takes place not in one central cavity, but in every living tissue and not only furnishes the heat to keep the body warm but, in some unknown way, gives directly muscular energy, nervous energy and the energy for all the functions of living. Moreover, unlike any engine, the body builds and repairs itself constantly. If the building food is not sufficient in amount the waste of tissue proceeds faster than its repairs, and there is a constant loss of body substance. The body can store fuel food as fat for use in case of need.

FOOD PRINCIPLES

In this and other series of lessons we have already discussed the food principles to some extent. Let us consider them now somewhat more in detail.

PROTEIDS

Different Proteids

The proteids are more difficult to understand than the other food principles because different members of the class seem at first sight to have little in common. A few simple experiments that will isolate some typical proteids in a more or less pure state will serve to give a clearer image.

Gluten

To a quarter of a cup of flour add very slowly a tablespoon of water and stir it until the flour is completely moistened, then work the dough in the hands until it becomes smooth and elastic, and finally wash it under cold water until fresh water added no longer grows milky. This will take from fifteen to twenty minutes. If a little iodine is at hand add a drop. If no blue color appears the starch is all washed out. There will be left in the hands a sticky, elastic mass, called gluten. Save part of this for comparison with other proteids and bake the rest in a hot oven.

Casein

Add a little acid, such as lemon or vinegar, to some milk, and heat it gently. Wash the curd thus formed in order to separate it from the whey. The curd is chiefly composed of casein.

With a knife scrape a piece of lean meat until the tender muscle fibre is separated from the firm white

Myosin

connective tissue. The fibre represents one of the chief proteids of meat, called myosin. Beside the gluten, the casein, and the myosin, put the white of an egg, and you have before you the four chief representatives of the proteids of our food.

Legumin

If we could add to them legumin, the proteid found in peas, beans, and other members of the pulse family, we should have a fifth important member of the class.

If we compare these substances, we shall find that although at first they seem very different, they yet have certain properties in common. All, for instance, to a greater or less extent, show the elasticity and tenacity that is so marked in gluten; all of them are toughened by a high temperature; and all when dried may be ground to powder similar in texture and appearance.

Composition of Proteids

These physical likenesses, however, would hardly be sufficient to place these substances in one group. It is only when we consider the chemical composition of each and the function that each has in the body that we are justified in classing them together as proteids. Proteids are substances containing the elements carbon, hydrogen, oxygen, nitrogen, sulphur and frequently phosphorus. They alone of the food principles are able to supply nitrogen, one of the essential elements in all living things, whether animal or vegetable, and one that we are forced to obtain from our food, since, although we are surrounded by an atmos-

phere that is nearly four-fifths nitrogen, we cannot utilize it in this form.

Gelatin

Beside the true proteids, there are certain other substances which also contain nitrogen, but which are classed separately because they cannot alone supply the nitrogen needed by the body, though they can replace part of the proteid in the diet, and perform its function. Gelatin is one of the best known of these substances. They are called gelatinoids or albuminoids. Ossein, of which bone is largely composed, keratin, the horny material present in the hair and in the horns and hoofs of animals, collagen, forming the greater part of the connective tissue of meat, are all representatives of the same class of substances. All these named may be changed into gelatin by boiling.

Extractives

Certain other nitrogenous substances called extractives, are present in some foods. These may help give the flavor to meat. They form the chief ingredient of the extracts of beef on the market; and it is these that give the chief value to beef tea and to clear soup. The extractives act as stimulants rather than as true foods since they neither build tissue nor act as fuel, but they seem to play some role in digestion.

Nomenclature

The proteids, gelatinoids, and extractives, are sometimes classed together under the general name of protein. This is the usage of the United States Government pamphlets. The nomenclature applied to the nitrogenous substances is very confusing, since each author seems to have adopted his own. Albumi-

noid, for instance, is sometimes used to designate the true proteids, and sometimes is applied to the gelatinoids. Proteid is sometimes used in a much more limited sense than we have given to it, including only certain classes of the substances ordinarily designated by the term.

In studying the subject, therefore, one must first of all ascertain the writer's use of terms.

CARBOHYDRATES

Composition

Grains of Potato Starch.

The carbohydrates are so called because they are composed of the elements carbon, hydrogen and oxygen, the last two in the proportion in which they are found in water. This last statement, although it is generally made in defining carbohydrates, is not strictly true, since a few of the less common members of the class are found to vary somewhat from this proportion.

The principal carbohydrates may be classed in three groups. The following table shows the chief members of these different groups, so far as our food is concerned.

Classification of Carbohydrates

Starch (or Amylose) Group.	*Cane Sugar (or Sucrose) Group.*	*Grape Sugar (or Glucose) Group.*
$C_6 H_{10} O_5)_n$	$C_{12} H_{22} O_{11}$	$C_6 H_{12} O_6$
Starch	Cane Sugar (Sucrose)	Grape Sugar
Dextrin	Malt Sugar (Maltose)	(Dextrose)
Cellulose	Milk Sugar (Lactose)	Fruit Sugar (Levulose)
Gums		
Glycogen		

That the second and third groups bear a definite

Corn Starch. Rice Starch.

(From *Hygiene*, by Parks.)

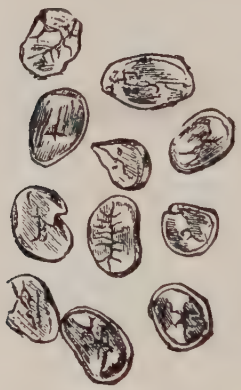
chemical relation to the first may be seen by a comparison of their formulae.

Starch

Starch is the most important of the carbohydrates from the standpoint of food. It is familiar to us all as the fine, white, glistening powder of "corn starch" and of laundry starch. We may easily, by washing it, obtain it also from grated potatoes and from flour. Starch is found only in the vegetable kingdom, and is manufactured by green plants and stored in different parts of the plant in the form of tiny grains lying within the plant cells.

Structure of Starch

The structure of these grains has been very hard to determine because of their minuteness. It was thought for a long time that they were composed of a cellulose envelope enclosing the true starch, and that by the action of water and heat these grains swelled and the cellulose envelope burst.



Bean Starch.

A later theory was that the starch grain was built up in alternate layers of starch cellulose and starch granulose.

The late work of a German botanist, Meyer, seems to show that the grains are in the form of sphero-crystals, each made up of many tiny particles. These radiate from a center, and at the same time are arranged in concentric layers. The particles are of two kinds called by Meyer alpha-amylose and beta-amylose. These may be compared to the starch cellulose and starch granulose of the older theory. Upon the application of heat and moisture the beta-amylose swells and becomes gelatinous, forming a solution. The alpha-amylose is affected only by a temperature much above the boiling point, or by long continued heating.

Starch Grains

The starch grains in different plants differ much in form, size and general appearance, as shown in the

illustrations. The relation of the difference in structure to digestibility is not well determined.

Dextrin is a substance having the same general composition as starch, but unlike it in some of its properties. It is chiefly important to us in that it is an intermediate product of the change of starch into sugar. **Dextrin**

Glycogen is the form in which carbohydrate is stored in the body until it is needed for use. It is

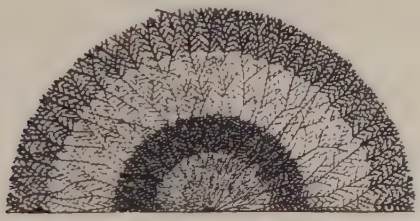


Diagram Representing the Supposed Structure of a Sphero-Crystal of Starch, Showing Radial and Concentric Arrangement.
From A. Meyer.

found chiefly in the liver and is sometimes called animal starch.

Cellulose is so slightly digested that we do not put it in the list of human foods, yet it is important from two standpoints. First, it gives the necessary bulk to food; and second, it so encloses the nutrients in vegetables and fruits that it must be definitely considered in cookery. **Cellulose**

Allied to the gums are the pectose and pectin that are concerned in the making of jelly from fruit juice. The gelatinous substance obtained from Irish moss also belongs in this class. The sugars will be discussed under the special foods.

FATS

Composition

The fats, like the carbohydrates, are composed of carbon, hydrogen and oxygen, but with these elements in very different proportions from that in which they exist in the carbohydrates. There is a much larger proportion of carbon with less oxygen than in starch and sugar, and this accounts for the readiness with which they burn and the intense heat that we get from them. They are of both animal and vegetable origin. Those which are liquid at ordinary temperature we often speak of as oils.

Water and Mineral Matter

In discussing the value of a food we commonly consider only the organic principles. Although water is absolutely necessary it is so easily supplied and so abundant that we do not have to consider whether or not it is present in our food as we purchase it. This is not true of mineral matter to so great an extent, but it is largely so, except in the case of growing children. The mineral matter will, as a rule, take care of itself if we provide the other substances needed.

Nutrient Ratio

By food value or nutritive value we ordinarily mean the amount of organic nutrients present in the food. In determining the importance of any particular food, we consider not only the total amount of the nutrients

present, but the relation that the proteid bears to the other nutrients. This is often called the *nutrient ratio*. The nutrient ratio of potatoes, for example, containing two per cent of proteid and eighteen of starch, is 1 to 9. In reckoning this ratio, fat is changed into its starch equivalent, that is, one part of fat is considered equal to two and a quarter of starch.

Classification of Foods

The following classification of the food principles may help to fix in the mind their relationship.

Nutritive Ingredients (or Nutrients) of Food

- **Organic**
  - Nitrogenous
    - Proteids, e.g., albumin, casein, gluten, etc.
    - Gelatinoids, e.g., gelatine, etc.
    - Extractives.
  - Non-nitrogeneous
    - Carbohydrates, e.g., sugar, starch.
    - Fats.
- **Inorganic**
  - Mineral matters.
  - Water

Use of Food Principles in the Body

Proteid, e.g., white (albumen) of eggs, curd (casein) of milk, lean meat, gluten of wheat, etc.	Forms tissue.	All serve as fuel to yield energy in the forms of heat and muscular power
Fats, e.g., fat of meat, butter, olive oil, oils of corn and wheat, etc.	Are used or stored as fat.	
Carbohydrates, e.g., sugar, starch, etc.	Are used or transformed into fat.	
Mineral matters (ash), e.g., phosphates of lime, potash, soda, etc.	Share in forming bone, assist in digestion, etc.	

DIETARY STANDARDS

Amount of Food Required

In addition to a knowledge of food constituents, of the proportion of which these exist in our food, and of the use of food in the body, we need to know the amount of food necessary to supply our daily needs under different conditions. Many factors will influence not only the total amount of food that we need, but also the proportions in which we shall use the proteids, the carbohydrates and the fats. The flesh weight of the body is important in deciding the amount of proteid (that is, the muscle weight, not the total weight of the body) since the greater the flesh weight the greater the nitrogenous waste. The shape of the person, whether tall or thin, or short and plump, influences the amount of fuel food required, since the amount of surface exposed affects the loss of heat. The degree of activity has an important influence upon the amount of all the food principles. Variations in climate to a certain extent affect the amount of heat to be produced in the body, and occupation also has an important influence.

Food for Different Ages

The age of the individual is, within certain limits, one of the greatest factors. The growing child needs a large amount of building material, while the old person needs distinctly to lessen the tissue building foods. The accompanying diagram gives an idea of the way in which these proportions vary with different ages. It will be seen that the proportion of proteid is much greater in comparison with other food materials

in the case of the child than of the adult. The total amount of food is also greater in proportion to body weight in the child than in the adult. Although not shown in the table, mineral salts are needed in large proportion in the child's diet, while they may well be cut down in the diet of the old. The amount of food needed increases rapidly from birth to about four

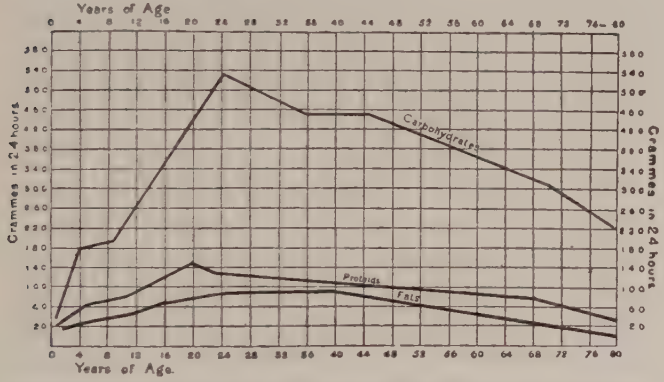


Diagram Showing the Varying Amounts of Food Principles Required at Different Ages.

years of age, very slowly from four to about ten, with a rapid increase from this time to twenty-four. From ten to twenty-four the carbohydrates should increase in amount more rapidly than the other food principles.

Nutrient Ratio

To put in terms of the nutrient ratio the difference between the diet of the child and that of the adult—in the adult diet the ratio is about 1 :5.3; in the diet of the child, 1 :4.3.

Standard Dietaries

These statements are of course true only approximately, yet one familiar with children must recognize in them a fair generalization from the facts.

The proportions of the different food principles needed daily constitute the dietary, and dietary standards have been made up taking into account as far as possible these different conditions. These dietaries are sometimes called experimental, and sometimes statistical, according to the method used in formulating them. An experimental dietary is the result of careful observations of the effect of different proportions of food nutrients upon an individual under determined conditions. The statistical dietary is the outcome of the study of the actual ration of large numbers of people. Each of these has its drawbacks. In the first case it is difficult to decide how far the result is due to individual idiosyncrasy, and a large number of experiments must be tried before the personal factor can be eliminated. In the second case it is hard to determine whether some variation in the diet might not produce better results.

Experimental Dietaries

An example of the first method of formulating dietaries is that of Professor Atwater's respiration calorimeter, sometimes called "the man in a box," described in one of the government pamphlets. A small room was constructed in the laboratory with flues arranged to bring in fresh air and to carry off the products of respiration. Each of these flues was arranged so that the temperature and composition of the air entering

and going out might be determined. A man lived in this room for several days at a time, his food being given to him by means of slides in a double wall. A sample of each food given was analyzed and a determination of the number of calories yielded by it made by means of the bomb calorimeter. All food taken was carefully weighed, and the excreta of the body were analyzed so that an accurate estimate could be made of the total income and outgo of the body. See illustration on page 32.

Statistical Dietaries

Many statistical dietaries have been taken, some of the most valuable being those of the German army. Experiments have been made there as to the effect of the addition of certain articles of food to the diet, and the conclusions have been of much value. Similar dietary studies have been made at many schools and universities.

From a careful comparison of dietaries made up in these two ways certain standards have been determined upon. The American standards vary in some important points, notably in the amount of fat used, from those of Europe. Some of these dietaries are given here.

Standard Dietaries

	Proteid Grams	Fat Grams	Carbohydrat's Grams	Total Grams	Calories
Voit					
Woman at moderate work (German)	93	44	400	536	2425
Man at moderate work (German)	118	56	500	674	3055
Man at hard work (German)	145	100	450	695	3370
Playfair.					
Man with moderate exercise (English)	119	51	531	701	3140
Active laborer (English)	156	71	568	795	3630
Hard-worked laborer (English)	185	71	568	824	3750
Atwater.					
Woman with light exercise (American)	80	80	300	460	2300
Man with light exercise (American)	100	100	360	560	2815
Man at moderate work (American)	125	125	450	700	3520
Man at hard work (American)	150	150	500	800	4060

There are twenty-eight and thirty-four hundredths grams (28.34) in one ounce. A man at moderate work requires, therefore, according to the American standard, about four and one-half ounces of proteid, four and one-half ounces of fat, and nearly a pound of carbohydrate daily.

Chittenden's Experiments

The dietary standards that we have been considering are those that have been accepted generally since work of this kind was first begun. Some late experiments conducted at Yale University by Professor Chittenden and others, indicate that a much smaller amount of food, especially of proteid, may better serve the purposes of the body, than the larger amounts indicated in these standards. The experiments were carried out upon men representing three different classes of individuals. The first class was composed chiefly of

professors and instructors. The second represented the moderate worker. The third class were trained athletes. The experiments covered a period of five months, and the proteid taken daily varied from about thirty-five to fifty grams per day, while the total number of calories yielded was from twenty-five to twenty-eight hundred a day. The general conclusion drawn from these experiments is that under ordinary conditions of life, with an ordinary amount of work, bodily health and vigor are maintained as well, if not better, on a minimum proteid diet than on the amount given in the generally accepted standards.

Dr. Folin's Experiments

Some careful experiments and analyses recently made by the physiological chemist, Dr. Otto Folin, at the McLean Hospital, Waverly, Mass., indicate that about twenty grams of proteid represents the actual daily proteid wastes of an average sized man under ordinary conditions. That is, only about three-fourths of an ounce of proteid material is necessary per day in an adult to rebuild the nitrogenous tissue of the body that wears away through use.*

Such radical differences from standards found by long experience to give good results in health and strength must be considered very carefully before being accepted. But in this as in many other ways, we may be obliged to revolutionize our ideas of food.

Amount of Food to Furnish Required Proteid

We must not fail to distinguish between the amount of proteid required and the amount of food containing proteid. If, for example, meat be supplied containing

*See Report of the Lake Placid Conference on Home Economics, 1905, and American Journal of Physiology, March, 1905.

18 per cent of proteid (a fair average), a little more than a pound and a half of the meat will be required to furnish the four and a half ounces of proteid. Bread containing 9 per cent of proteid would be required to the amount of three pounds. Nearly two pounds and a quarter of eggs, with 13.1 per cent of proteid, or about eighteen eggs, would be necessary to supply four and a half ounces of pure proteid.

Example for Practice

Taking the percentage composition from the accompanying table, calculate the amount of milk that would be required daily to furnish four and a half ounces proteid. How much potato would be required? How much corn meal?

Calculations

Calculations: From the table, milk is found to contain 3.3% of proteid or 1 oz. contains .033 oz. protein. To furnish 4.5 ozs. would require

$$4.5 \div .033 = 136+$$

As a pound contains 16 ozs., 136 oz.$=8\frac{1}{2}$ lbs. A pint of milk weighs about 1 lb., so about $4\frac{1}{4}$ quarts would be required to provide 4.5 ozs. of proteid.

Potatoes *as purchased* contain 1.8% proteid.

$$4.5 \div .018 = 250$$

250 oz. $=$ 15 lbs. (aprox.)

A bushel of potatoes weighs about 60 lbs., consequently about one peck of potatoes would be required.

Corn meal contains 8.9% proteid and by the same calculations 3 lbs. 2 ozs. will be found to contain 4.5 ozs. of proteid.

Balanced Ration

It is by no means a matter of indifference whether the proteid be derived from any one of these food

materials, or from a mixture of different ones. The other food ingredients present must be taken into account. For example, the three pounds of bread

Composition of the Edible Portion of Some Common Foods

	Ash, per cent.	Water, per cent.	Proteid, per cent.	Fat, per cent.	Carbohydrates, per cent.	Calories, per lb.
Milk	0.7	87.0	3.3	4.0	5.0	325
Butter	3.0	11.0	1.0	85.0	.....	3,605
Cheese	3.8	34.0	25.9	33.7	2.4	1,950
Eggs	1.0	73.7	13.4	10.5	.....	720
Beef (sirloin)	1.0	61.3	19.0	19.1	.....	1,155
Beef (round)	1.1	65.5	20.3	13.6	.....	950
Mutton (leg)	1.0	63.2	18.7	17.5	.....	1,085
Fowl	1.0	63.7	19.3	16.3	.....	1,045
Cod (boneless salt)	19.0	55.0	27.3	0.3	.....	490
Cod (fresh)	0.9	82.5	16.7	0.3	.....	325
Oysters	1.1	88.3	6.0	1.3	3.3	230
Apples	0.3	84.6	0.4	0.5	13.0	290
Bananas	0.5	75.3	1.3	0.6	21.0	460
Sugar	.....	.....	.....	.....	100.0	1,857
Flour (white)	0.5	12.0	11.4	1.0	75.1	1,650
Flour (entire wheat)	1.0	11.4	13.8	1.9	71.9	1,675
Bread	1.1	35.3	9.2	1.3	53.1	1,215
Crackers	1.8	6.8	10.7	8.8	71.9	1,905
Macaroni	1.3	10.3	13.4	0.9	74.1	1,665
Corn meal	1.0	12.5	9.2	1.9	75.4	1,655
Rice	0.4	12.3	7.8	0.3	79.0	1,630
Potatoes	1.0	78.0	2.2	0.1	18.4	385
Dried Beans	3.5	12.6	22.5	1.8	59.6	1,605
Dried Peas	2.9	9.5	24.6	1.0	62.0	1,655
Lettuce	0.9	94.7	1.2	0.3	2.9	90
Almonds	2.0	4.8	21.0	54.9	17.3	3,030
Raisins	2.3	14.6	2.6	3.3	76.1	1,605
Chocolate	2.2	5.9	12.9	48.7	30.3	2,860

(See pages 36 and 37 for charts giving graphic representation of these foods.)

would furnish also more than a pound and a half of carbohydrates, a great excess of the required amount. The meat would vary in fat, but estimating

the per cent as twenty, the pound and a half would yield four and eight-tenths ounces, more than would be required for the day. The quantities used of these different foods must then be so adjusted that the nutrients will be in approximately the right proportion. The deciding upon these different quantities from the percentage composition of the food is the essential point in calculating dietaries.

Practical Use of Dietaries

The question will probably come to each one—of how much practical use for the everyday housekeeper is this study of dietaries. In the first place, it would mean the expenditure of a great deal of time if one should undertake to determine each day's rations in this way. In the next place, it is impossible to know the actual composition of the food that we eat, except in a few cases. We may be fairly sure of the composition of the egg, but when meat varies in proteid from 12 per cent to 22 per cent as it does according to the Atwater analyses, how are we to determine the composition of the particular cut that we are using to-day? Moreover, even if our meal were prepared so that the exact proportions of nutrients were furnished, it is quite possible that one member of the family might eat too large a proportion of the proteids and another too much of the carbohydrates.

Another element of uncertainty lies in the difference in composition between cooked and uncooked food. Rice, for example, according to the tables, contains 79 per cent of carbohydrate and 7.8 per cent of pro-

teid. But if you will weigh a cup of rice before it is cooked, and the same rice after it is cooked, you will find that it has gained perhaps four times its original weight. In other words, a quarter of a pound of cooked rice will only furnish about a fourth as much nutrient as a quarter of a pound of rice without the added water. Often we can allow for this difference in the calculation of our dietary; but sometimes we know too little about the changes which take place in cooking to do this. Finally, even if we know exactly what we eat we do not know what we assimilate. Is there, then, any use in the dietary standard?

Variation from Standard

In two ways it is of great service. In the first place, it is a standard by which we may test our diet if we extend our experiment over a sufficiently long period. At the beginning of a month let us take account of stock, estimate the amount of food materials on hand, and then keep careful account for a month of all food brought into the house; at the end of the month we will again estimate what we have on hand and in this way ascertain the amount of raw material used. Table IV, with the details which follow, gives an example of a carefully calculated dietary. The composition of the various foods was taken from Bulletin No. 28 of the office of Experiment Stations, U. S. Department of Agriculture.* If, on calculating the food value of the different materials, we find that for the

* "The Chemical Composition of American Food Materials" which may be obtained by sending five cents *in coin* to the U. S. Department of Agriculture, Office of Experiment Stations, Washington, D. C.

number of persons served we have a distinct variation from the standard diet, we can legitimately conclude that there is something wrong. If, for example, we find that the amount of proteid calculated in our food materials is twice as much as that supposed to be required, we shall conclude that either our families must be using a much larger amount of proteid than would be conducive to the best health, or there must be much unnecessary waste, and in either case, an investigation would be needed.

Errors in Dietaries

Another way in which the dietary standard is of especial service, is in enabling us to judge what error in diet is responsible for some particular weakness or peculiarity in any member of the family. A girl of fourteen may be unusually thin or may appear languid and tired, and everything point to improper feeding as the cause. The first thing to do in this case would be to see whether the child's diet were deficient in any one of the three nutrients, and if so bring the diet up to the standard. In dealing with abnormal conditions, then, or with large masses of people, or with diet over an extended length of time, the dietary standards may be applied to great advantage. It is not necessary to apply it strictly to each individual at each meal.

The calculation of a few dietaries is very useful in giving us a definite idea of the general composition of foods, and so making it easier to estimate the amount of different nutrients which we are providing

at ordinary meals, without the tediousness of reckoning each meal in detail.

In such calculations the following factors are used to reduce the results to the standard of one man at moderate work.

Factors used by the U. S. Department of Agriculture in Calculating Meals Consumed in Dietary Studies.

Factors

Man at hard muscular work requires 1.2 the food of a man at moderately active muscular work.
Man with light muscular work and and boy 15-16 years old require 0.9 the food of a man at moderately active muscular work.
Man at sedentary occupation, woman at moderately active work, boy 13-14, and girl 15-16 years old require 0.8 the food of a man at moderately active muscular work.
Woman at light work, boy 12, and girl 13-14 years old require 0.7 the food of a man at moderately active muscular work.
Boy 10-11 and girl 10-12 years old require 0.6 the food of a man at moderately active muscular work.
Child 6-9 years old requires 0.5 the food of a man at moderately active muscular work.
Child 2-5 years old requires 0.4 the food of a man at moderately active muscular work.
Child under 2 years old requires 0.3 the food of a man at moderately active muscular work.

Home Studies

In making dietary studies all food used should be weighed, but the following data may be of use for approximate home calculation:

1 measuring cup = ½ pint.
16 tablespoons = 1 cup.
3 teaspoons = 1 tablespoon.

A cup of water weighs about 8.3 oz., of milk 8.6 oz., of cream 8.4 oz., of butter 8.4 oz., of lard 7.5 oz., of sugar 8 oz., and a tablespoonful of the foregoing weighs about 0.5 oz. A cup of meal weighs 5 oz., of sifted flour 4 oz., of oatmeal 2.7 oz., of cream of wheat 6 oz. A cubic inch of meat or butter weighs about 0.5 oz. An egg without shell weighs 1.6 oz. A slice of bread ½ in. thick weighs 1 oz., a heaping teaspoonful of sugar 0.4 oz.

Since the foregoing was written, Professor Irving Fisher of Yale University has devised a comparatively simple method of calculating individual dietaries. His method is given in full in Bulletin No. 13, "Food Values," of the A. S. H. E, and in the supplement to this series of lessons. Before going further it is well to become familiar with this method.

Instead of starting with the percentage composition by weight of foods, the basis is percentage by "food units" or fuel and energy value, or in other words, by calories. This does away with the varying amounts of water contained in food which, while absolutely necessary, has no fuel value and the method places the fats on the same basis as the carbohydrates and proteins.

A table is given showing the average food units required for men, women and children, based on Professor Chittenden's standards.

After becoming familiar with this method, the approximate total food value of one's daily diet may be reckoned mentally and the proportion of the three chief food principles may be obtained with but little figuring.

Note the additional work required by this method in connection with Question 21 of this lesson p. 217.

TEST QUESTIONS

The following questions constitute the "written recitation" which the regular members of the A. S. H. E. answer in writing and send in for the correction and comment of the instructor. They are intended to emphasize and fix in the memory the most important points in the lesson.

FOOD AND DIETETICS

PART I

Read Carefully. The Department of Agriculture Bulletin No. 142, "The Nutritive and Economic Value of Food," should be studied in connection with this lesson. *Make your answers full and complete.*

1. What to-day is included in the food problem?
2. What factors affect the proportion of the income spent for food?
3. At current prices in your locality, give a list of foods you would provide for a day's ration at 20 cents per person for raw food material. At 30 cents. At 40 cents.
4. To what extent can waste in food be eliminated?
5. How do animal and vegetable foods compare in cost?
6. Which would be the cheaper source of proteid, beefsteak at 25 cents per pound, milk at 8 cents per quart, bread at six cents per pound, corn meal at 4 cents per pound? Give details of calculations.
7. How is the heat and energy of the body produced?
8. What is meant by the term calorie? How is it that mechanical energy can be measured by this unit?
9. How does the amount of heat produced by proteid compare with that obtainable from an equal amount of starch? With that from an equal amount of fat?

10. What relation has digestibility to food value?
11. What are the five food principles? Give their functions. Which of the food principles is most important?
12. What is meant by proteid? Name the most common representatives of the class found in food.
13. If possible, perform the experiments in separating some of the proteids as described and report.
14. How does gelatine differ from the true proteids? How may it be obtained?
15. What is the most important carbohydrate from the standpoint of food? What is its source?
16. How do fats differ from carbohydrates?
17. What is meant by food value? By nutrient ratio?
18. How are dietary standards determined?
19. What factors affect the amount and proportion of food needed?
20. Of what practical value to the housekeeper are dietary standards?
21. Calculate the amount of proteid, carbohydrate, and fat in your own diet for one day as nearly as you can. Give details of calculation.
22. What questions have come to you in the study of this lesson?

Note. Question 21 is optional. After completing the test sign your full name.

FOOD AND DIETETICS

PART II

SPECIAL FOOD STUFFS

Animal and Vegetable Food Stuffs

In the selection of foods one of the questions that will come up will be that of the relative value of animal and vegetable foods. An increasing number of people are confining their diet largely, if not exclusively, to vegetable products, while others add to these such animal substances as do not imply the taking of life, such as milk and eggs. Is a mixed diet essential for health? Or may we at will choose exclusively from the animal or the vegetable kingdom?

Distinction

Certain broad distinctions between animal and vegetable food will immediately present themselves. Speaking generally, animal foods are richer in nitrogenous matter, while vegetable foods are the chief source of carbohydrates. This becomes much more evident if we compare the two in a dry condition. Milk, for instance, makes a poor showing in proteid as compared with dried peas and lentils, or even with rice. But if we take the total solids of the milk as a basis of comparison, eliminating the 87 per cent of water, the case is quite otherwise. This is the fair method, for the dried peas and rice absorb many times their weight of water in the process of cooking, so that the analysis of the raw material is quite different from that of the cooked food.

Hutchison gives the following composition of a few typical dried foods:

One hundred parts of dried lean beef contain 89 parts of proteid.

One hundred parts of dried fat beef contain 51 parts of proteid.

One hundred parts of dried pea flour contain 27 parts of proteid.

One hundred parts of dried wheat contain 16 parts of proteid.

One hundred parts of dried rice contain 7 parts of proteid.

To this we may add:

One hundred parts of dried milk contain 25 parts of proteid.

Carbohydrates

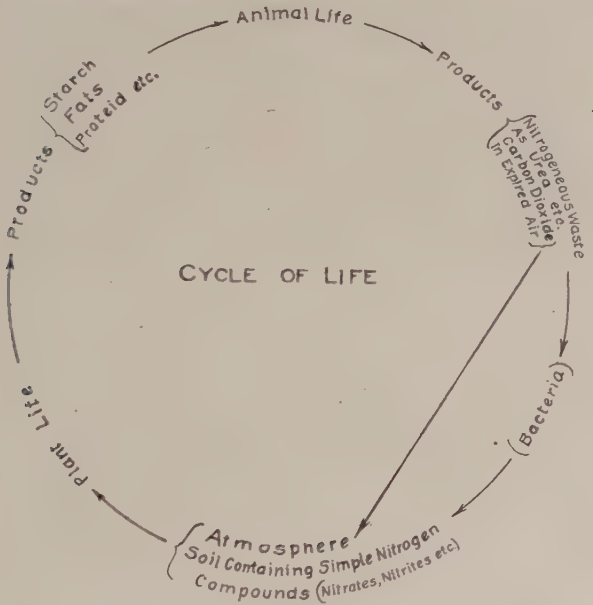
On the other hand we find our carbohydrates almost wholly in the vegetable kingdom. Milk is the only important exception to this. In milk, dried, we find 38 parts of carbohydrate to 100 of the total solids.

Comparative Cost

Another difference between animal and vegetable food is found in their comparative cost. Animal food as a rule is much more expensive than vegetable. This is not difficult to understand when we remember that our animal food has been put through a further process of manufacture than the vegetable food. If the grain raised, instead of going directly to man as food, is used to feed cattle, and these in turn are slaughtered to furnish nourishment for human beings, the process necessarily adds to the cost of the food. This process, as well as the fact that plants are in general *builders* of material, while animals *break down* the complex compounds built up by the vegetables, is graphically shown by the accompanying diagram.

Digestibility

The same intermediate process which adds to the cost of food increases also its digestibility, though the less complete absorption by the system of vegetable



than of animal proteid seems to lie in the fact that in the plant the proteid is enclosed within cellulose walls and ordinary processes of cooking do not always free it, rather than in any difference in the proteids themselves.

In deciding from which kingdom we shall choose

Source of Proteid

our diet, we consider almost wholly the proteid. As we have seen, carbohydrates must necessarily be obtained chiefly from vegetable sources, and it seems to be a matter of indifference whether the fat of the diet is of animal or vegetable origin. With the addition of milk, butter, cheese, and eggs, it is not difficult with care to provide a satisfactory dietary without the use of meat.

Vegetarian Diet

The case is different when vegetables form the only source of food supplies. Because of the great excess of carbohydrates and the presence of indigestible matter in the form of cellulose, a great bulk of food must be taken in order to get the necessary proteid. As a matter of fact, nearly all purely vegetarian diets are deficient in proteid. The extra cost of the animal proteid is justified by its availability since it may be obtained without an excess of other substances and since it is easily assimilated.

MEAT

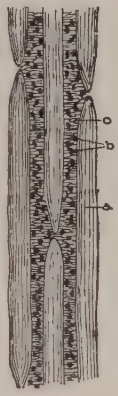
In the ordinary family the greater part of the proteid diet is probably furnished by meat, so that a knowledge of the composition and nutritive value of this article of food is important. The structure of the

Structure

meat may be best seen if one with a sharp knife scrapes a small piece of meat, thus separating the muscle fibre from the white connective tissue. Under the microscope the muscle fibre is seen to consist of bundles of smaller fibres held together by delicate connective tissue in which fat cells are imbedded. These muscle

fibres vary in length in different kinds of meat, and the length of fibre probably plays some part in the digestibility of the meat—the short fibre meats being the more digestible.

The toughness or tenderness of meat depends partly upon the muscle fibres and partly upon the connective tissue, though as a rule the same conditions that have made the connective tissue tough and strong will have had a similar though less effect upon the muscle fibre. In general the muscles that are most used or most exposed to wind and weather will be both tougher and richer in flavor than those not so exposed. The young animal will, of course, have more delicate tissues and less toughened fibres than the older or harder worked animal.



FIBRE OF MEAT.

a Fibre
b Fat
c Connecting tissue

Composition

The composition of different pieces of meat, even from the same animal, differs greatly, the proteid of beef, for instance, varying all the way from twelve per cent to twenty-one, according to the cut of meat and to the feeding of the animal from which it is obtained.

Proteids of Meat

The proteids of meat include a number of different substances, the chief of which are fibrin, myosin and albumin. After the animal is killed the myosin coagu-

lates, thus causing the hardening of the muscle, known as rigor mortis. In this condition the meat is very tough, and the hanging of meat is practiced in order to give time for the disappearance of this rigor by the re-solution of the myosin.

Albumen

The presence of albumin in the meat can be easily shown by soaking a small portion of the meat in water for a few minutes, and then heating this water. The albumin dissolves in the water and coagulates upon heating just as white of egg would do under similar conditions. The scum that forms in the water when a piece of meat is boiled, is largely this same albumin. Beside the true proteids, gelatine may be obtained from meat in varying quantities. The connective tissue upon boiling becomes gelatine, and it is due to this as well as to the gelatine obtained from the bones that water in which meat has been cooked so often sets into a jelly. The color of meat is due largely to the same substance that gives the color to blood,

Flavor

haemoglobin. Its flavor depends chiefly upon the nitrogenous substances called extractives, though the characteristic taste of pork and mutton is caused partly by the fats they contain. These extractives have no real food value, but act as stimulants.

Fat of Meat

The fat in meat varies even more in amount than the proteid; beef, as purchased, containing from five and eight-tenths per cent to more than forty per cent.

Even in meat that appears lean much fat is present lying between the muscle fibres. This may be seen

upon heating the meat in water, when globules of fat appear from even the leanest meat. The solidity of the fat is due chiefly to the stearin that is present.

Water

The amount of water in meat varies very much. A lean cut of beef may have as much as seventy-five per cent of water, while a fat piece might not contain more than fifty per cent. In general the more fat the less water there is present, so that in buying it is economy to select meat that is moderately fat.

Factors in Digestibility

From the standpoint of digestibility, meat is an excellent food. It is among the most easily digested of the proteid foods. As a rule raw meat is more digestible than cooked, and rarely cooked meat more digestible than that which is well done. The cooking of meat has its value not in adding to the digestibility but in developing flavor, so that the meat becomes more palatable; and in rendering it more safe, by destroying certain parasites that are sometimes present in raw meat, particularly in pork, and bacteria that under certain circumstances may cause dangerous decomposition.

There is much difference in the digestibility of different meats. Pork is ranked among the less digestible meats, since it requires a longer time for complete digestion than do other varieties. This is probably due to the large amount of fat closely combined with the muscle fibres. Bacon fat, on the other hand, from its different form, is generally found to be easily digested.

Mutton and beef stand equally well in this respect. As has been suggested before, short fibred meats are in general more easily digested than long fibred ones, yet veal is an exception to this. Hutchison explains this by suggesting that the fibres of veal easily elude the teeth on mastication, and that the comparatively insipid character of the veal fails to excite a free flow of gastric juice. It would seem that this absence of extractives would be the more important factor.

Effects of Cooking

How far the cooking of meat alters its chemical composition is not wholly determined. Some interesting experiments at the University of Illinois have taught us much about the losses that take place in the cooking. It is shown that in whatever way meat is cooked, there is much loss of weight, amounting either in boiling or in roasting to a fourth or even a third of the original weight. This loss is partially proteid and fat, but consists still more largely of water. The loss of water appears to be caused partly, at least, by the hardening and consequent contraction of the muscle fibre, the water being mechanically forced out.

Losses in Boiling

An interesting experiment has been tried in regard to the effect of salt in preventing or accelerating the losses in meat. A salt solution was prepared, having the same density as that of the juices of the meat, and a piece of meat was boiled in this. It was found that a very small amount of the juices of the meat were lost in the water and practically none of the salt penetrated

into the interior of the meat. The conclusion drawn was that very little interchange of the water and the meat juices could take place unless the medium in which the meat was cooked was either less or more dense than the meat juices themselves.

Cost of Meat

Meat does not form a cheap source of proteid food, but the cost can be lessened very much by care in selecting the cheaper cuts. As a rule these cheaper parts need longer cooking than the more expensive tender cuts, and, as has been suggested before, the fuel must be taken into account in estimating their cost. Where the cheapness of the meat is not counterbalanced by the additional expense of the fuel a great variety and a satisfactory diet may be obtained with only the occasional use of the more expensive portions. As has been said, the nutritive value of the cheaper parts is as great as that of the more tender portions.

Soups and Broths

The nutritive value of meat soups, broths and extracts has been much discussed. Often in estimating this value too little allowance has been made for the method used in preparation. A clear soup contains a very small amount of real food. Its value lies in the extractives that give it flavor, and in the small amount of gelatin that it contains, and in its power to stimulate the flow of the gastric juices, and so whet the appetite rather than satisfy it. The meat from which such a soup has been made still contains a large portion of its nutritive value, and although because of its lack of flavor it cannot be used as it is, it may be

Extractives

made palatable and attractive by the addition of spice or seasoning, or by its combination with a small portion of fresh meat. Unless large quantities of soup are made, it ought to be possible, in the ordinary household, to utilize the soup meat in some way.

Extracts of Meat

The commercial extracts of meat are similar to clear soup in that they contain practically nothing but the extractives. A more nutritious broth may be made if the meat, cut in small pieces, is allowed to soak for some time in cold water and then is heated to a low temperature, not above 180 degrees Fahrenheit, and kept at this point for some hours. Toward the end of the process the broth may be brought to the boiling point for a few minutes in order to dissolve all the gelatin possible. The brown flecks of albumin that form must be served in the broth and not be strained out. Even made in this way, the value of the broth is small compared with that of meat, but it is much greater than that of the clear soup.

Beef Juice

Raw beef juice is valuable as a food. If the beef be cut small, and thoroughly pressed, a much larger amount of proteid is obtained than by any other treatment. The round of beef, very slightly broiled and pressed, may yield as much as seven per cent of proteid and four per cent of extractives.

FISH

Nutritive Value and Digestibility

One of the most natural substitutes for meat is fish. Its nutritive value is much like that of meat, although it contains a somewhat smaller proportion of

proteid. It also has the advantage of being as a rule easily digested, and so is particularly adapted to the needs of a person of sedentary habits. It is probably this fact that has given rise to the false idea that fish is a particularly good brain food. As a matter of fact, it is no more a brain food than meat or eggs or any other proteid food. The cost of fish is generally less than that of meat, so that it furnishes a cheap source of the necessary proteid. The value of fish depends, however, upon nearness to the source of supply much more than does that of meat, since fish deteriorates rapidly upon keeping.

Classification of Fish

For food purposes we may divide fish into white and fat fish; or we may take Hutchison's classification of, (1) fish with more than five per cent of fat, such as eels, salmon and herring; (2) fish with from two to five per cent of fat, as halibut and mackerel; and (3) fish with less than two per cent, such as cod and haddock. Fish with a small amount of fat is more easily digested than the more oily variety. Beside the proteid and fat in the fish, we obtain a certain amount of gelatine. The sturgeon furnishes isinglass, a very pure variety of this substance.

Cost of Fish

In estimating the cost of fish, allowance must be made for the large amount of waste so that the price per pound tells by no means the whole story of its value from an economic standpoint. The following analysis by Miss Williams shows the waste in

cooked fish as served at the table, and also the amount of nutrient present.

Composition of Fish

Fish	Part analyzed	Per cent Waste. Bones, etc.	Per cent Gelatin	Per cent Water	Per cent Nutrients
Sardines	Whole	4.91	.....	42.17	52.92
Salmon	Section	5.99	0.53	61.06	32.02
Trout	Whole	8.23	0.55	67.12	24.10
Eels	Heads removed	11.66	1.09	53.29	33.96
Mackerel	Whole	10.51	0.25	65.21	24.03
Cod	Section	15.99	0.43	63.78	19.79
Salt cod	Section	6.13	0.33	67.68	25.85
Haddock	Whole	35.10	0.80	46.46	17.64
Whiting	Whole	21.50	0.86	61.29	16.35
Turbot	Anterior and head	31.20	0.59	53.09	15.12
Halibut	Section	6.84	0.03	69.35	23.78
Plaice	Flesh	.....	.....	79.85	20.14
Soles	Whole	22.02	0.74	61.18	12.06
Oysters	Shell contents	.....	.....	77.71	22.29
Smelts	Whole	18.86	0.38	65.20	15.56

Variety in Diet

Fish, beside being an economical source of nitrogenous substances, has much value in satisfying the demand for variety in food. Any lack in nutrients is frequently supplied by the sauces with which it is served, and by the fat used if it is fried. It would seem to be an error from the standpoint of food values to serve a rich sauce with a fish like salmon that already contains a high proportion of proteid and a large amount of fat, but an egg sauce served with a light fish like cod or haddock has its justification, not only in the additional flavor imparted, but in the additional food value.

Shell Fish

Oysters may be taken as a good type of the various shell fish that we use. The analysis of oysters shows a composition somewhat similar to that of milk,

although they are higher in nitrogen and lower in fat than milk.

Average Composition of Oysters. (Langworthy.)

(Exclusive of liquid.)

Water	88.3
Nitrogenous substances	6.1
Fat	1.4
Carbohydrates	3.3
Salts	1.9

Comparative Cost

When milk is seven cents a quart and oysters are twenty-five, the amount of food material purchased for a given amount differs greatly in the two. When oysters are fifty cents a quart they must be distinctly regarded as a luxury, used for the purpose of providing variety, and not as a valuable source of food. Oysters are one of the few animal foods that contain a large amount of carbohydrates. These are present in the liver of the oyster in the form of glycogen.

Digestibility

The oyster is especially easy of digestion, but this digestibility is lessened by cooking. This is particularly true when the oyster is overcooked. An objection to the use of the raw oyster is that during the so-called fattening of the oyster, that is done in shallow water, it may become contaminated with typhoid germs derived from sewage. Some noted epidemics have been traced to this source. This simply means that greater care should be taken in the supervision of such a food supply in order that it may be protected from such possible contamination.

Clams Lobster.

Of other shell fish commonly used, clams have a similar composition to that of oysters, but contain

a tougher muscle, while lobsters and crabs are generally considered somewhat indigestible because of the firmness and compactness of their fibre. The difficulty here seems partially at least to be the failure to properly masticate the flesh, as is true in so many other cases, and also the difficulty of obtaining the food in an absolutely fresh condition.

Dried and Smoked Fish

Dried and smoked fish deserve a place in the diet for the sake of variety, and because, since the water has been eliminated, a large amount of food material is obtained for a small amount of money. The use of certain varieties of canned fish has become general. Salmon is perhaps the most satisfactory of these. Special care should be taken in using canned fish to remove it immediately from the can after it is opened, and to use it within a short time. Fish that has been frozen should be cooked immediately after thawing, since it decomposes much more rapidly than fish which has not been frozen.

Cooking

Fish, particularly some varieties, such as cod, occasionally contains parasites, but these are destroyed by thorough cooking. It is essential that *all* fish used should be thoroughly cooked, although this does not mean that it should be cooked at a high temperature. A temperature of from 180 to 200 degrees Fahrenheit continued long enough to coagulate the proteid and render the fish opaque instead of clear, gives far more satisfactory results than boiling.

As in other cooking of flesh, this principle is apparently violated when fish is cooked in a hot oven, or

fried, but as a matter of fact, the violation is only true so far as the outside layers are concerned, and this sacrifice is made in order to keep the shape of the fish and to develop the flavor.

Comparative Costs of Protein and Energy as Furnished by a Number of Food Materials at Certain Prices

Kind of Food Material.	Price per pound.	Cost of protein per pound.	Cost of energy per 1000 calories.
	Cents.		
Codfish	10	$0.94	$0.49
Codfish steaks	12	.71	.36
Bluefish	12	1.22	.59
Halibut	18	1.18	.38
Cod, salt	7	.44	.22
Mackeral, salt	10	.68	.11
Salmon, canned	12	.55	.13
Oysters, "solids" (30 cents per quart)	15	2.50	.65
Oysters, "solids" (60 cents per quart)	30	5.00	1.30
Beef, sirloin	25	1.53	.26
Do	20	1.23	.21
Beef, round	14	.77	.16
Beef, stew meat	5	.36	.07
Beef, dried "chipped"	25	.97	.32
Mutton chops (loin)	20	1.54	.14
Mutton leg	22	1.48	.25
Pork roast (loin)	12	.85	.09
Pork, smoked ham	22	1.65	.13
Milk (7 cents per quart)	3½	1.06	.11
Milk (6 cents per quart)	3	.91	.09
Lobster	18	3.05	1.24
Wheat flour	3	.27	.02
Corn meal	2	.22	.01
Potatoes (90 cents per bushel)	1½	.88	.05
Potatoes (45 cents per bushel)	¾	.44	.02
Cabbage	2½	1.79	.20
Corn, canned	10	3.57	.22
Apples	1½	5.00	.07
Bananas	7	8.75	.22
Strawberries	7	7.00	.38

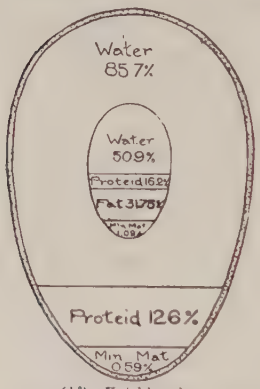
From *Fish as Food*

EGGS

Composition

One of the most general substitutes for meat is the egg. One would at first thought expect eggs to be of much the same composition as milk, since each fur-

nishes food for the growing animal, but when the different conditions are considered, the reason for the variation in this respect is readily seen. The egg must contain a large amount of nourishment in the most compact form. It must furnish all the materials necessary for growth, but it does not need to provide for activity to the extent that milk does. Consequently we find the carbohydrates wholly absent, and a much larger proportion of solid material than is present in milk. The solids are in the form of proteids, fourteen and eight-tenths per cent; fat, ten and a half per cent; and mineral salts, one per cent. This refers to the edible part only.



(After Hutchison.)

Diagram showing Composition of White and Yolk of an Egg.

White and Yolk

The white of the egg contains twelve per cent of proteid, with practically no fat and a small amount of mineral matter, while the yolk has sixteen and two-tenths per cent of proteid and almost thirty-two per cent of fat.

The greater part of the mineral salts are also in the yolk, although the sulphur that causes the blackening of the silver spoon with which we eat our egg is chiefly in the white.

While eggs form a valuable meat substitute, it is difficult to use them wholly in the place of meat, since it takes so many eggs to equal a pound of meat. From eight to nine eggs constitute a pound. If the eggs have the composition given and meat contains eighteen per cent proteid, it would require about twelve eggs to furnish as much proteid as one pound of meat; and one who would have no difficulty in eating half a pound of beefsteak at a meal, would not wish to eat an equal weight of eggs.

Eggs like meat need to be supplemented by carbohydrate material. Bread and eggs furnish a satisfactory combination as well as bread and meat. Raw eggs are usually considered more easily digested than cooked eggs, although some experiments show that the cooked egg leaves the stomach in a shorter time than the uncooked. This is explained by the statement that the raw egg is digested largely in the intestine. Its failure to excite the secretion of gastric juice in the stomach makes it possible to use raw eggs in the diet when the stomach requires rest.

Digestibility

Hard cooked eggs take a longer time to digest than those lightly cooked, but from recent government experiments they seem to differ little in the completeness with which they are digested, an egg boiled three minutes having 8.3 per cent of its nitrogen undigested at the end of five hours; one boiled for five minutes having 3.9 per cent undigested, and one boiled for twenty minutes having 4.2 per cent remaining. Eggs

cooked at 180 degrees Fahrenheit for five and ten minutes respectively were totally digested in five hours. Possibly the rapidity of the digestion of the hard cooked egg may depend on the fineness of mastication.

Cost

Whether eggs are to be used freely depends largely upon their price. Eggs at fifteen cents a dozen may be so used, while at fifty cents a dozen they can not be regarded as an economical source of food.

MILK

Milk is often called a perfect food. This is true, however, only in a limited sense. Hutchison gives five tests of a perfect food.

Tests of a Perfect Food

First, such a food must contain all the nutritive constituents required by the body; proteids, fats, carbohydrates, mineral matter and water.

Second it must contain these in their proper relative proportions.

Third, it must contain, in a moderate compass, the total amount of nourishment required daily.

Fourth, the nutritive elements must be capable of easy absorption, and yet leave a certain bulk of unabsorbed matter to act as intestinal balance.

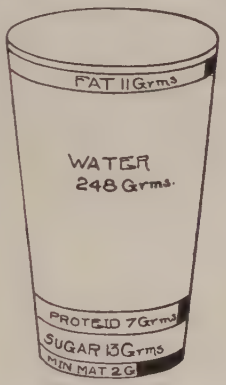
Fifth, it must be obtainable at a moderate cost.

Of these tests milk meets only the first perfectly. It contains the two proteids, casein and albumen. It contains the fat so familiar to us in the form of cream and butter. The carbohydrates are represented in it by milk sugar or lactose. The mineral salts are par-

ticularly valuable, and consists chiefly of calcium compounds, including calcium phosphate.

Proportions of Nutrients

When we come to the second test, we find a different condition. An average sample of milk contains 87 per cent of water, three and three-tenths per cent proteid, four per cent fat, and five per cent carbohydrate, with seven-tenths of one per cent mineral matter. This proportion is of course right for the young animal, who demands a large proportion of muscle-building food, but it is far from a desirable proportion for the adult.



(After Hutchison.)
Composition of a Glass of Milk.

Remembering that the nutrient ratio is about one to five, or to put it in another form, that the adult requires approximately five times as much carbohydrate (or its equivalent) as proteid, we see that milk must be supplemented by some food containing a large proportion of carbohydrate before it can adequately supply the needs of the adult. As a matter of fact, experience has taught us to use with milk such a food as bread, thus supplying the needed starchy material.

Nutrient Ratio

The third condition is not met better than the second. At least four quarts of milk a day would be necessary for the complete nutrition of a healthy man doing a

moderate amount of muscular work. Milk also is lacking in the bulk of unabsorbed matter that it leaves.

Cost

The fifth condition may or may not be fulfilled. In the city the price of milk is too high for it to be an economical source of food if used exclusively. On the other hand in the country the price of milk is often so low that this condition might be fulfilled.

A comparison of the food value obtained from one pound (a pint) of milk and from that of a similar weight of some common article of food, is given, with the cost of each at prices taken from two different sections of the country:

Comparative Food Value of Milk

1 lb. of milk	furnishes	.033 lbs.	proteid	.04 lbs.	fat	.05 lbs.	carbohydrate				
1 " " sirloin steak	"	.165 "	"	.161 "	"	no	"				
1 " " eggs (8 eggs)	"	.131 "	"	.093 "	"	no	"				
1 " " bread	"	.092 "	"	.013 "	"	.531lbs.	"				
1 " " potatoes (one 60th bu.)	"	.018 "	"	.001 "	"	.147 "	"				

From milk	at (.04 per qt.	or .02 per lb.)	1 lb. of proteid	costs	$ .60
" "	" (.07 "	" " .035 "	")	1 " "	"	"	1.06
" sirloin steak	at .18 a lb.			1 " "	"	"	1.09
" " "	" .25 "			1 " "	"	"	1.52
" eggs	at (.15 per doz.	or .10 per lb.)		1 " "	"	"	.76
" " "	(.36 "	" " .24 "	")	1 " "	"	"	1.83
" bread	at .05 per lb.			1 " "	"	"	.54
" " "	.08 " "			1 " "	"	"	.87
" potatoes	at .60 per bu.	or .01 per lb.		1 " "	"	"	.56
" " "	" $1.20 " "	" .02 " "		1 " "	"	"	1.11

In addition to the proteid, the money invested would have purchased, in the case of milk more than a pound of fat and of sugar; in that of meat an equal amount of fat; in the case of bread more than five pounds of starch; in that of potatoes nearly seven pounds of

starch; while three-fourths of a pound of fat would be furnished by the eggs.

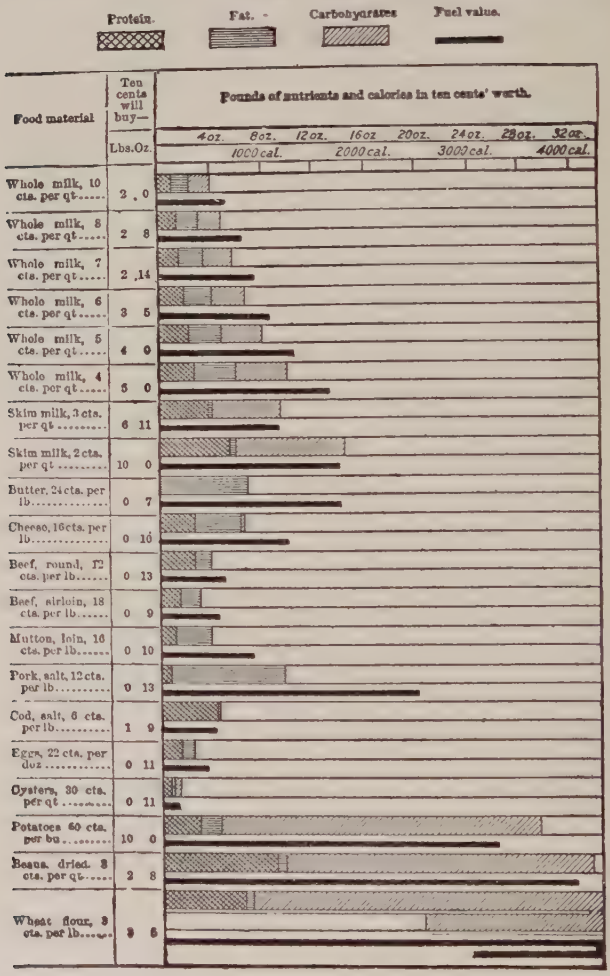
A Food Not a Beverage

Even at city prices milk might well be substituted to a certain extent for other proteid foods. The habit of many people of using milk simply as a beverage in addition to the food required, is perhaps responsible for the fact that many people find milk indigestible; the difficulty lies not with the milk but with the over-abundance of food. An experiment was tried at the Maine Agricultural College on the effect of a limited and an unlimited amount of milk at the University boarding house. These experiments are reported in the Government Bulletin called Milk as Food, and the following conclusions are drawn:

An Economical Food

"First, the dietaries in which milk was more abundantly supplied was somewhat less costly than the others, and at the same time was fully as acceptable. Second, the increased consumption of milk had the effect of materially increasing the proportion of protein in the diet. Third, the milk actually supplied the place of other food materials, and did not, as many suppose, simply furnish an additional amount of food without diminishing the quantity of other materials. Fourth, the results indicate that milk should not be regarded as a luxury, but as an economical article of diet which families of moderate income may freely purchase as a probable means of improving the character of the diet and of cheapening the cost of the supply of animal food."

Chart of the Pecuniary Economy of Milk and Other Foods at Given Prices


Protein.
Fat.
Carbohydrates
Fuel value.
Food material
Ten cents will buy—
Lbs.Oz.
Pounds of nutrients and calories in ten cents' worth.
4oz. 8oz. 12oz. 16oz 20oz. 24oz. 28oz. 32oz.
1000 cal. 2000 cal. 3000 cal. 4000 cal.
Whole milk, 10 cts. per qt..... 2 0
Whole milk, 8 cts. per qt..... 2 8
Whole milk, 7 cts. per qt..... 2 14
Whole milk, 6 cts. per qt..... 3 5
Whole milk, 5 cts. per qt..... 4 0
Whole milk, 4 cts. per qt..... 5 0
Skim milk, 3 cts. per qt..... 6 11
Skim milk, 2 cts. per qt..... 10 0
Butter, 24 cts. per lb..... 0 7
Cheese, 16 cts. per lb..... 0 10
Beef, round, 12 cts. per lb..... 0 13
Beef, sirloin, 18 cts. per lb..... 0 9
Mutton, loin, 16 cts. per lb..... 0 10
Pork, salt, 12 cts. per lb..... 0 13
Cod, salt, 6 cts. per lb..... 1 9
Eggs, 22 cts. per doz..... 0 11
Oysters, 30 cts. per qt..... 0 11
Potatoes 60 cts. per bu..... 10 0
Beans, dried, 8 cts. per qt..... 2 8
Wheat flour, 3 cts. per lb..... 3 6

We may conclude that while it would not be economical to obtain our total food supply from milk, it is good economy to use it freely in connection with other foods to furnish part of the proteid of the diet.

Digestibility

The digestibility of milk varies very much with the method in which it is taken. If a small amount of liquid rennet or of the junket tablets so commonly found in the market, be added to a portion of warm milk, a thick clot forms. This is similar to the process that takes place in the stomach after milk has been swallowed. Milk properly, then, so far as its digestion is concerned, is a solid rather than a liquid food. Its digestibility depends largely upon the way in which this clot is formed. If the milk be swallowed rapidly, so that the rennin acts upon a large mass at once, one large clot is formed. If, on the other hand, the milk be sipped slowly, or eaten from a spoon, the action is slower and the curd is broken.

Addition to Milk

The same result in a more marked degree is obtained by the addition of certain substances, such as lime-water, to the milk; or by the mixing of the milk with bread, as is done in eating bread and milk. Some people who cannot use milk in its ordinary form have found that they could digest it without difficulty if a cracker were rolled into fine crumbs and stirred into the milk. The digestive juices that would act slowly upon a large mass of curd, act readily upon the same amount when it is broken into small clots.

Boiled milk has generally been considered less diges-

Boiled Milk

tible than uncooked milk, but some experiments seem to contradict this. The experiment station bulletin states that when cow's milk has been boiled before it is taken into the stomach it is likely to be precipitated in a more floculent form. Hutchison says that it has been found in the case of infants and calves that sterilized milk which has been kept at or above the boiling point for more than an hour is absorbed quite as well as milk which has merely been boiled in the usual way, and he concludes that boiling does not appreciably diminish the digestibility of milk.

On the other hand, the government bulletin states, after acknowledging that the results of experiments upon the subject are conflicting, that "the more common experience seems to indicate that cooking or heating the milk makes the proteids somewhat more difficult for most persons to digest, but there are exceptions to this rule, if it be a rule, for there are persons who cannot take fresh milk with comfort but with whom boiled milk agrees very well."

In this case as in many others we must wait for a larger number of experiments to be made before we can make very dogmatic statements.

Buttermilk Koumiss Skim-milk

Buttermilk is considered an especially digestible form of milk, while koumiss or fermented milk is of still greater value in this respect. Skim-milk deserves more general use than it has, since the proteid of the milk nearly all remains in this, and it is for the proteids

that we especially value the milk. Where skim milk is sold at a low price, it is economy to use it freely in cooking, supplying the needed fat in a less expensive form than cream.

The Composition of Milk

Casein

The composition of milk has already been stated in a general way. If we examine it more in detail, we find that the proteids of milk consist chiefly of two: casein or, as it is sometimes called, caseinogen. This forms about three per cent of the total of the milk. It is held in solution more or less completely by the salts of lime present in the milk. When acid is added to the milk, or it becomes sour, this casein is precipitated. When rennet is added the casein is coagulated and is changed in chemical composition. The scum that forms upon heated milk is chiefly casein.

Lact-Albumen

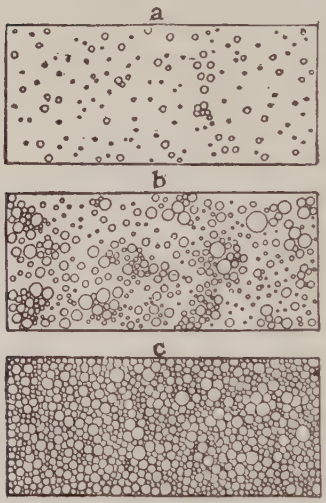
The other proteid present in milk is lact-albumen. This coagulates when the milk is heated for a long time. It is present in much smaller amount than the casein, forming only about one-seventh of the total proteid of the milk.

Milk Sugar

The sugar of the milk, forming between four and five per cent, is called lactose or milk sugar. It has two important characteristics. It lacks the sweetness usually associated with the name of sugar, having only a very slight sweet flavor, and it is considered the most digestible form of sugar, apparently fermenting in the

stomach or intestines with much less ease than do other sugars. For both of these reasons it is particularly suitable for the use of infants or invalids. The commercial article is obtained from milk, and is sold in the form of a fine white powder looking not unlike pulverized sugar. Aside from its use as a food it is extensively used in the preparation of pills.

Fats



Fat Globules of Milk Magnified 200 Times.

a Skim Milk. *b* Whole Milk. *c* Cream.

The fat of milk is present in the form of an emulsion. If one looks at a drop of milk through the microscope one sees a large number of tiny fat globules. That the fat is so finely divided is a factor in its digestibility, though fat derived from milk, either in the form of cream or butter, is also considered particularly digestible.

Mineral Matter

The mineral matter of milk consists largely of potash and lime salts, and of these salts the phosphates are the most abundant. These are important, not only in the building of bone tissue, but also, as has been suggested before, in holding the casein in solution.

Water

Water forms about 87 per cent of milk, and its chief use in this form is in holding other materials in solution. To compare milk with other foods, we should properly think of the solid ingredients alone, since the water has no more food value than water in any other form.

Souring

Milk readily undergoes many changes, some of them harmless and some more or less harmful. The most common change is that of souring. Bacteria present in the milk act upon the sugar and change it into lactic acid. After a certain amount of this acid has been produced, the growth of the bacteria is stopped, and no further change in the sugar takes place, though undoubtedly certain other changes take place both in the fat and in the proteid.

Use of Sour Milk

There is no evidence that sour milk is unwholesome. The objection to it seems to be chiefly one of taste. Its use in cooking produces good results, and many prefer it for some purposes to sweet milk since it seems to produce a more tender product than does the sweet milk. On the other hand, milk may under the action of certain bacteria produce most harmful products, and poisoning from these ptomaines is not uncommon where milk has been handled in an uncleanly manner and has been poorly cared for. A more serious danger from milk is that owing to the excellent food it furnishes for almost all bacteria, it is frequently a carrier of disease. Disease germs that in water would not multiply and would probably live only for a short

time, multiply abundantly in milk. It is because of the possibility of the presence of these harmful bacteria, rather than from any danger from sour milk, that we guard our milk supply carefully. Each hour that elapses between the milking of the cow and the use of the milk by the consumer, increases the number of bacteria present. One cubic centimeter of milk frequently contains from 400,000 to several million bacteria.

Pure Milk

Efforts to guard the milk supply have been directed in two ways. The sterilization or pasteurization of all milk is often recommended; but a more satisfactory method would seem to be the insuring of cleanly conditions upon the dairy farm where the milk is produced. The next essential after cleanliness is that the milk should be cooled rapidly when first milked, since the lower temperature makes the fluid less favorable for the growth of germs.

Care of Milk

In the household milk should be kept in perfectly clean vessels, and should be loosely, not tightly, covered, in order that there may be access of air to it, since the absence of fresh air favors the growth of certain putrefactive organisms. The entirely open vessel is only allowable in perfectly clean surroundings, not only free from dust, but with no strong flavoring substance near from which odors could be absorbed.

Condensed Milk

One form in which we often get milk is that of evaporated or condensed milk. This is simply milk

from which most of the water has been removed, and which has been made sterile by heating to a high temperature. It has usually been sweetened, and the sugar acts as a preservative. While it is a convenient form for use when fresh milk is not obtainable, its large amount of sugar renders it somewhat undesirable as a common article of diet, and also makes it unfit for many cooking purposes.

Milk Powder

There is being put upon the market now milk powder that seems to consist chiefly of the curd of the milk dried and ground. With the addition of water it forms a very fair substitute for milk.

Adulteration

Milk is perhaps more often adulterated than any other common article of diet. The most common form of adulteration is that of skimming or removing part of the cream. This can easily be detected, because it increases the specific gravity of the milk. To counterbalance this, water, which is slightly lighter than milk, is added in such proportion that the twice adulterated milk gives the same test as if it had not been tampered with at all.

Another adulteration that is sometimes practiced is that of adding coloring matter to the milk. This is usually done in order to conceal the blueness of the milk, when it has been watered.

Preservatives

Preservatives are frequently used. Of these boric acid is probably the least harmful, though some authorities contend that formaldehyde in the minute quantities in which it is used has no physiological

effect. A milk that will stand in a warm place for some hours and show no tendency to sour is open to the suspicion of having been treated in some such way. Ordinary cooking soda is sometimes added to neutralize the acidity that may be present because of the age of the milk. Salicylic and benzoic acids are sometimes found, while formaldehyde is used most of all.

MILK PRODUCTS

Butter

The importance of milk is hardly greater than that of its two chief products, butter and cheese. Butter consists chiefly of the fat of the milk with a small amount of water, of casein and of salt, with sometimes a little milk sugar. The average amount of fat contained is 82 per cent. The fats which are present may be put into two classes: Those derived from the so-called "fixed" fatty acids, and those from the volatile fatty acids. The fixed fatty acids are present in the form of stearin, the chief ingredient in beef fat, and of palmitin and olein. The amount of the volatile acids present differentiate butter from most of the other fats that we commonly use as food. The flavor of butter is produced apparently by the action of bacteria upon the cream, the different flavor of butter at different times of the year coming largely from differences in the kind and amount of bacteria that find their way into the milk. The "ripening" of the cream is often induced by artificial cultures of the proper bacteria. Many buttermakers abroad and in

some sections of our own country, depend entirely upon these bacterial cultures for the production of their butter flavor.

Changes

The rancidity of butter may be produced by changes taking place in the casein that is present, or from a decomposition of the fats themselves. Cooking lessens the digestibility of butter as it does that of other fats, probably because of the decomposition that takes place when fats are subjected to a high temperature, and the consequent freeing of irritating fatty acids.

Adulteration

The adulteration of butter consists chiefly in a substitution of other substances, either in whole or in part, for the butter fat, or of an inferior and "doctored" article. The coloring of butter is almost universal, but it is so generally accepted that it can hardly be classed as an adulteration, although it surely shows a false standard in foods when we insist upon buying a deep yellow compound colored with annatto or some other foreign material instead of the delicate straw-colored substance that most natural uncolored butter is.

The substitutions spoken of are chiefly either what is called renovated butter, or oleomargarine. Renovated butter is made by taking different lots of stale or rancid butter, melting it, allowing the curd to settle, and re-churning the fat with a small amount of milk. The product is certainly better than the rancid butter, but it cannot compare in flavor and in wholesomeness with fresh butter, and certainly should not be sold as such.

Renovated Butter

Butterine

Oleomargarine, or butterine, is made by clarifying the fat of beef and churning it in milk. It differs from butter in its composition in that it contains practically no curd, and is lacking in the volatile fatty acids that are present in the butter and characteristic of it. It is a cheaper product than butter, and the temptation to put it upon the market under the name of butter has consequently been great. There is absolutely no reason, however, why, sold under its own name, it should not be a very general article of use. There seems nothing to show that it is materially less digestible than butter itself; it does not grow rancid with the ease that butter does, and it is made in a perfectly cleanly and wholesome way, certainly so far as the best quality of it is concerned. Even if it is artificially colored, this is no worse than is true of butter. The difference in taste between it and butter is rather in an absence of the aroma that we find in the best butter, than in any disagreeable flavor present. Indeed, although each person thinks to the contrary in regard to himself, few people are able to distinguish it from butter by taste. It may be used in almost every way as a butter substitute. It is perfectly satisfactory to use in the making of sauces or upon vegetables or meat. It does not make so light a cake as butter, and is not satisfactory for this purpose, except that in a plain cake it may be substituted for part of the butter; and it cannot be used in candy making as, for some reason, it fails to combine with the other

materials and always separates out upon cooling. Since it is so much cheaper than butter it would be well to use it as a substitute for part of the more expensive material.

The present law in regard to it has lessened its sale to a great extent since it can no longer be artificially colored, but it is certainly only prejudice that prevents our accepting a pure white fat instead of a bright yellow one.

Cheese

Cheese, so far as nutritive value is concerned, stands almost at the head of our list of foods. Since it is made from the curd of the milk, and the water has largely been disposed of in the whey, while the fat is carried down with the curd, we have the most important part of the milk solids in a condensed form. The composition of the different varieties of cheese varies to quite an extent, but in a rough way we may say that cheese is one-third proteid, one-third fat and one-third water. Mineral salts are abundant as well, while a small amount of milk sugar is sometimes present.

Cheese Making

Cheese is prepared by the addition of rennet to milk. Coloring matter is generally added, and salt. After the curd has set, it is cut in small pieces and the whey allowed to drain off. The curd is then put into a press and allowed to remain for a few hours. After this the real curing or ripening of the cheese begins, and this process is allowed to go on for months in order to develop the flavor. This flavor is produced

by the action of bacteria, different varieties of bacteria giving us the different flavors of the various kinds of cheese.

Digestibility

While there is no question as to the nutritive value of cheese, there is more doubt as to its digestibility. In many countries cheese is used largely as a substitute for meat, and wherever it can be digested this is certainly a rational thing. Some people who have delicate digestions have no difficulty in digesting cheese, while others find it an extremely indigestible food. One difficulty seems to be that the cheese is frequently not chewed enough, and the digestive organs have to cope with lumps of the material.

Effects of Cooking

Cheese generally proves more digestible if it is finely divided and mixed with some starchy material like bread crumbs or macaroni. Another factor in its digestibility is the temperature at which it is cooked. Like all proteid foods, it is toughened and hardened by a high temperature. This is very evident in the case of such a dish as a Welsh rarebit, where over-cooking produces a tough, stringy, most indigestible mass. In combining cheese with such a dish as macaroni it is well not to allow the cheese to be at the bottom or the top of the dish, but to protect it from the high temperature by putting it between the layers of starchy material.

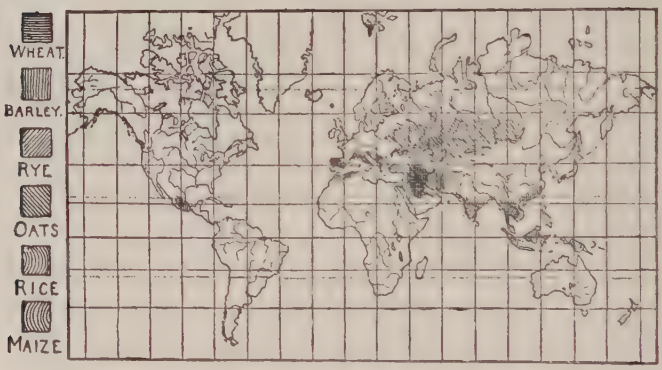
Matthieu Williams, in his chemistry of cookery, suggests the use of a little bicarbonate of potash, the old-fashioned salaratus, to make the cheese more

soluble and therefore more digestible. Sometimes after the cheese has become tough from the action of too high a temperature, it may be again made soft by the addition of this substance, or of bâking soda. Hutchison suggests that the disagreeable effect that cheese has upon some people may be due to small quantities of fatty acids produced in the process of ripening. The philosophy of the use of cheese at the end of a dinner seems to be that the cheese in small quantities aids the digestion of other foods, even though it is not always easily digested itself. Wherever, then, cheese can be used and digested without difficulty, it forms an excellent article of food, one that should be used more freely than is done at present.

CEREALS AND THEIR PRODUCTS

Importance

The most important of all our vegetable foods are without doubt cereals. Not only do they contain a large amount of nutriment, chiefly, but by no means wholly, in the form of carbohydrates, but their areas of growth are widely distributed, and their power of adaptation to different climates and conditions is usually great. This alone would render them exceedingly



PROBABLE NATIVE HOME OF THE GRAINS.

(From *Corn Plants* By Fredric LeRoy Sargent.)

important as food for the human race. Of them all wheat is undoubtedly the most important from its wide distribution and its power of adaptation to different conditions. Rice follows closely in importance, while corn, oats, rye, barley and millet each have an important place in the food of the world. The home of the

cereals seems for the most part to have been Central Asia, nearly all, except rice and corn, originating there. Corn is supposed to have originated in Mexico. From these centers their production has spread through all parts of the world.

Composition

A comparison of the composition of some of the different cereals in forms commonly used is given in the following table:

Composition of Cereals.

	Per Cent of Water.	Per Cent of Proteid.	Per Cent of Carbohydrate.	Per Cent of Fat.
Wheat flour (entire)	11.4	13.8	71.9	1.9
Cornmeal	12.5	9.2	75.4	1.9
Oatmeal	7.3	16.1	67.5	7.2
Rye flour	12.9	6.8	78.7	.9
Barley meal and flour	11.9	10.5	72.8	2.2
Barley (pearled)	11.5	8.5	77.8	1.1
Rice	12.3	8.	79.	.3

Wheat

Wheat derives its special importance from the fact that it will grow in so many different climates and under so many varying conditions. It may be sown either in the fall or in the spring, and receives its name of winter or spring wheat, according to the time of the planting. Many varieties are found, such as red wheat and white wheat, hard and soft wheat.

Varieties

The hard wheats contain a larger proportion of gluten, and therefore a smaller proportion of starch than do the soft wheats. Wheat from which macaroni is manufactured, is an exceedingly hard variety. Successful attempts have been made within a few years to grow macaroni wheats in this country, and much of it is now produced in Dakota. Though hard wheat is

THE PRINCIPAL GRAINS.
(Redrawn from *Corn Plants.*)

used chiefly for making pastes like macaroni, excellent bread can be made from it also, as is shown by experiments made at the So. Dakota Agricultural College.

Winter wheats as a rule are softer than spring wheats. So-called pastry flour is made from the softer wheats. Much of our bread flour is now made from mixtures of winter and spring wheat, and great care is exercised in the combining of these in order to keep an even standard.

Section of a Grain of Wheat.
From a Maine Exp. Station Bulletin.

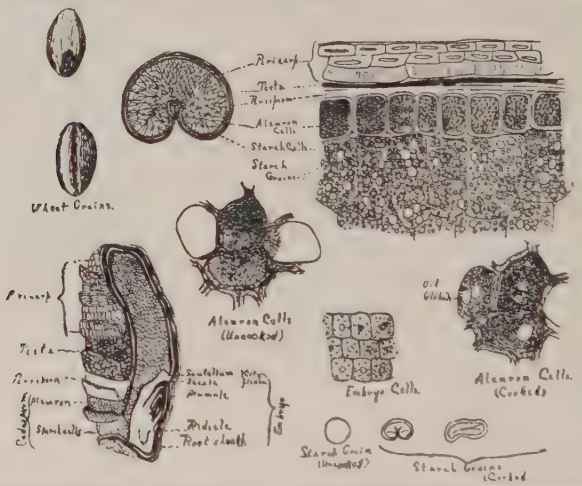
Flour

The process of manufacturing flour is carried out differently by different manufacturers, so far as its details are concerned, but the main features are the same. The wheat as it comes to the mill is first of all cleaned, by screening to get rid of any large foreign substances that may be present in it, and by "scouring" to get rid of the fine dirt that may adhere. The next process is that known as breaking. The wheat is cut by corrugated iron rollers provided for the purpose. There are generally five breaks in all. Each "break" is put through a number of siftings. The meshes of the bolting cloth through which this sifting is done are graduated in size, and the products accordingly vary in

Bolting

Scalping

fineness. The finest particles are called the dustings, the coarsest are the scalpings, while between these are the middlings,—germ, medium and fine. The scalpings from the first break undergo a second breaking and are again separated by sifting as in the first break,



SECTIONS OF A WHEAT GRAIN SHOWING THE STRUCTURE AND DIFFERENT PARTS.
(From Original Drawings.)

and this process continues through all the breaks.

Mixing and Testing

The flours on the market are made from mixtures of the products of the different breaks. When a flour is mixed it is tested by making a portion of it into a small loaf and baking it, and comparing this loaf with that made from some standard flour. The scalpings from the last break constitute the bran. This is al-

most wholly cellulose and is therefore not digestible by human beings, but much of the so-called Graham flour on the market is simply a mixture of white flour with some of this bran. True Graham flour is really wheat meal made by grinding the entire kernel.

Whole Wheat Flour

So-called whole wheat flour contains the inner portion of the bran only. The cellulose is very finely divided, so that it is less irritating to the digestive organs than the bran in Graham flour.

There is little difficulty today in obtaining good flour, but the different brands vary in composition, and so do different lots of the same brand, in spite of the effort to keep them constant. This means that a different treatment must be used. It is well, then, in the household, to experiment a few times with a new lot of flour before condemning it as poor and returning it.

Standards

Some false standards have been set up in regard to flour. The best bread flour is not pure white, but yellowish in tint. It readily retains the impression of the fingers, if a little is pressed together in the hand. It always has a slightly gritty feeling, while pastry flour is much smoother and more velvety to the touch.

Breakfast Foods

Within a few years the use of cereals as breakfast foods has become general. We have now not only the standard meals, which have been used for a long time, but a multitude of patent preparations as well. The Maine agricultural experiment station found that of fifty varieties of cereals purchased in the market, only

about twenty had been on sale for more than three years. Many of these are only new in name, or differ very slightly from those before used. Within a short time there has been added to our list of breakfast cereals many that claim to be predigested foods, and some that make absurd claims with regard to their wonderful food value, while others stand for what they are, without pretence.

Probably there is comparatively little to choose between different preparations of the same grain, so far as their chemical composition goes. The analysis of the uncooked food, however, by no means represents the composition of the cereal as we eat it. An analysis of boiled oatmeal, for instance, gave: Water, 84.5 per cent; protein, 2.8 per cent; carbohydrate, 11.5 per cent; fat, 5 per cent. Comparing this with the analysis of oatmeal given on p. 99, we find only about one-sixth the per cent of nutritive material, with a corresponding increase of water. A cereal that would absorb a greater weight of water would show still greater variation.

Digestibility of Cereals

The digestibility of the cereals is influenced by the coarseness of the particles. The coarser foods are highly desirable in many cases, especially where a sluggishness of the intestines exists, and in other cases are very irritating to the delicate lining of stomach and intestine. Individual needs must determine the use of each.

Most of the cereals, even those that are steam

Time of Cooking

cooked, need much more cooking than is ordinarily given them in order to sufficiently hydrate the starch. Of the foods supposed to be ready to eat, it is difficult to speak definitely, for lack of careful experimentation. In most of them a certain proportion of the starch has been converted into dextrin and sugar. Two questions arise in regard to this. Has the starch been sufficiently changed so that it no longer is indigestible as uncooked starch; and is it desirable to have the starch digested? There seems to be a tendency in our modern life to depend too largely upon predigested foods, particularly in the case of children. This means a tendency toward the lessening of the power to digest. It is certainly a question whether it is not best to take our starch undigested but in such a form that it can be easily acted upon by the digestive juices, rather than to have the work done outside the body.

BREAD

History

Bread was one of the earliest foods of man. That it was used long before history was written, the discoveries of modern times have shown us. In Switzerland, in the lake dwellings of prehistoric times, there have been found not only stones for grinding meal and baking bread, but even bread itself, in the form of round cakes. The first mention of bread in literature is in Genesis, in the words of Abraham to the angels, "I will fetch a morsel of bread." The Egyptians knew the art of breadmaking, and baked loaves and cakes in great variety of form and flavor. One ancient Greek writer names sixty-two kinds of bread in use; and in Rome there were many bakeries, where not only was the baking of bread done, but the grain was pounded and sifted, to prepare it for use.

Kinds of Bread

In our own day bread is found in a great variety of forms, many of them characteristic of certain nations; familiar examples are the black bread of Germany, the oat cakes of Scotland, the hard rye cakes of northern Sweden, baked only twice in the year, and the passover cakes or unleavened bread of the Jews.

Bread forms the staple food of a large section of the human race, and is often the only means of subsistence of the very poor. Mr. Goodfellow, in some investigations made in London, found that in the worst districts fifteen per cent of the children ate only bread for the

twenty-one meals of the week, while forty per cent more had other food only two or three times a week.

Good Bread

It is essential that so universal a food should be nutritious, palatable, and digestible. To fulfil these conditions, the flour used must be rich in nutriment; the bread must be light and porous, that as large a surface as possible may be exposed to the digestive juices; and the cooking must develop the flavor, and render the food materials assimilable to the greatest possible extent. The necessary ingredients of bread are flour of some variety and liquid for moistening it. Salt for flavoring is required by almost every one, and to most of us the term bread implies some agent for lightening the dough.

Wheat Bread

Wheat is the flour most commonly employed not only because of its widespread growth but because of the presence in it of the proteid called gluten, or more strictly speaking, of the proteids that upon the addition of water form gluten. Gluten is an important aid in the making of bread light in that being an elastic tenacious substance it retains the gas as it is formed in the dough. In the process of cooking, the gluten hardens and thus enables the loaf to retain its shape. This function of gluten may be compared to that of soap in the water from which soap bubbles are blown.

If some gluten be prepared from flour, as in the experiment on page 41, and baked, the value of this substance in lightening the dough will be appreciated.

Other Breads

Of the other cereals, rye makes the lightest bread as its proteids form with water a sticky substance not so elastic or tenacious as the gluten of the wheat, but sufficiently so as to retain much gas. Corn flour, however, makes only a flat and crumbly loaf unless egg be added to increase the elasticity of the dough.

The most desirable bread flour is one rich in gluten.

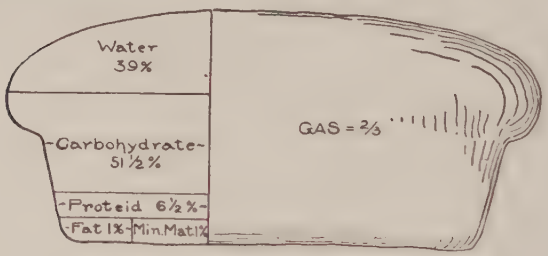


DIAGRAM SHOWING COMPOSITION OF A LOAF OF BREAD.

(After Hutchison.)

Even very hard macaroni wheat may be made into excellent bread as has been shown at the South Dakota Agricultural Experiment Station. If a flour poor in gluten and rich in starch is to be used a stiffer dough must be made than with the opposite conditions. In spite of the efforts of the manufacturers to maintain a constant standard in flour each barrel varies somewhat, and slightly different treatment may be needed.

Leavening Agents

Many different agents for lightening the dough have been used at various times. The ancient leaven was made by allowing flour and water to stand in a warm

place till it fermented. Part of this dough was used to start the fermentation in a new mixture of flour and water. In some sections of our own country "salt rising" bread is commonly used. In England aerated bread, made by forcing carbon dioxide under pressure into the dough, has been advocated and used to some extent.

Yeast Bread

The most common method of lightening the loaf, in this country at least, is by means of yeast. Yeast comes into the household in three forms, that of liquid yeast, compressed, and dried yeast. The last is most often used by those too far from the source of supply to obtain compressed yeast in good condition. It makes satisfactory bread, but the process is a long one, as time must be allowed for the dry yeast to take up water and renew its life processes. Liquid, or home brewed yeast, prepared usually from potato with the water from a few hops, frequently with the addition of sugar and flour, and the whole fermented by means of the addition of a "pitching" yeast, is much less used than formerly. Aside from the trouble of preparation, it is open to the disadvantage of usually containing many bacteria and wild yeasts. Many think, however, that the fine texture and delicious flavor of old fashioned home made bread was due in part to the use of this yeast.

Compressed Yeast

Compressed yeast is a by product of the distillery or the brewery. It is skimmed from the top of the fer-

menting liquor, is washed, strained, mixed with a small amount of starch and pressed into large cakes. At the distributing centers it is cut and wrapped in foil and sold for one or two cents, according to locality. It is, on the whole, the most satisfactory yeast to use in bread making, though it is rarely, if ever, free from the bacteria that cause the souring of bread when conditions are right for their growth.

Chemical Process

The changes that take place in the process of bread-making are largely those of fermentation. Some of the starch of the flour is changed to sugar, and the sugar is broken up into alcohol and carbon dioxide. If the fermentation goes too far the alcohol is changed to acetic and other acids and the bread becomes sour. Yeast is not the sole agent working; bacteria and not yeast are responsible for the souring, while the change of starch into sugar is probably accomplished by bacteria or some enzyme (ferment) present in the flour.

Chemical changes, such as the change of some of the starch into dextrin and some of the sugar into caramel, which takes place especially in the crust of the bread, are caused by the heat of the oven, while the same agent is responsible for the driving off of the alcohol and carbon dioxide present.

Methods of Making

A few years ago bread was almost invariably made by what is called the long process. A small amount of yeast was used and the bread was allowed to rise over night. Now more often the bread is set in the morning and the whole process is carried through in six hours.

The advantage of the latter method is that it makes it possible to watch the process and regulate the temperature more carefully than can be done if the bread is set at night. As temperature is an important factor in the growth of the yeast, too low a temperature hindering its growth, and too high a temperature favoring the growth of the acid producing bacteria, this is a distinct advantage. The most favorable range of temperature is from 75 degrees to 90 degrees F.

On the other hand, the long process produces a loaf of a texture preferred by many, and some experiments tend to show that it may be slightly more digestible.

Graham and Whole Wheat Bread

There has been discussion for many years over the comparative value of graham, whole wheat and white bread. Several years ago graham bread was urged upon every one as the only satisfactory bread. After a time the conclusion was reached that the coarse particles of the graham flour were too irritating to the intestinal wall, and its use was discouraged except where this very irritation was desirable, as in case of constipation. Then came the era of whole wheat bread, showing like the graham a high percent of nutriment. At one time it seemed to be considered almost a crime to use any other bread than this. The presence of phosphates in larger amount than in white flour and the higher proportion of proteid seemed a sufficient reason for encouraging its use by every one.

The latest government investigations have proved

White Bread More Nutritious

that this was a false assumption. While from the chemical standpoint it is true, from the physiological one it is not. Less of the material of whole wheat bread is available for use in the body, or in other words, a larger proportion is excreted in the feces than in white bread, so that whole wheat is not superior to white bread in *real nutritive value*. It is hurried through the intestines more quickly and thus given less chance for absorption than is true of the white bread. The phosphates are so closely attached to the outer cellulose wall that they probably do not furnish any more material to the body than is obtained from bread made of white flour.

Combinations with Bread

Although bread contains a fair proportion of proteid, about 9.2 per cent, it has too little proteid, too little fat, and too large an amount of starch to form in itself a perfect food. Instinctively we supplement it with these lacking ingredients. We use butter on our bread, we eat bread with meat, or we combine it with milk. In either case we are supplementing it admirably. Eggs, too, contain the lacking fat and proteid. Nuts eaten with bread and cheese so much used in many countries have scientific sanction.

Good bread is one of the cheapest, most nutritious, most easily and completely digested of all foods and well deserves its title the "Staff of Life."

SUGAR AS FOOD

Consumption

Mrs. Abel, in the government pamphlet Sugar as Food, calls attention to the fact that the consumption of sugar is everywhere increasing. In England eighty-six pounds per capita and in the United States sixty-four pounds per capita were consumed in the year 1895. This means simply the sugar that is manufactured in this form, and does not include that taken in the form of various fruits and vegetables.

The desire for sugar seems to be universal, and the fact that children always crave it would seem to be an indication that it is needed in their diet. On the other hand, we must remember that the manufacture of sugar is comparatively a late matter, and that earlier, a hundred years or so ago, people got along without it except as naturally present in their foods.

Concentrated Food

In using sugar it must be remembered that it is a highly concentrated food, and that it is therefore not to be used in such large quantities as would be right in the case of foods containing a large amount of water. It seems best fitted for assimilation by the body when it is diluted or used with other foods that give it the necessary bulk. It is also an error to use sugar, as is so often done, with other foods in such a way or in so large an amount as to disguise the natural flavor of these foods.

One of the advantages of sugar is that it passes quickly into the circulation, so that the energy obtained

from it is available in a very short period. It is particularly fitted for food in cases of exhaustion.

The bad effects of sugar are ascribed by Mrs. Abel to its use in too great quantity. Three or four ounces a day can be disposed of by the healthy adult with impunity. It has generally been thought that sugar is injurious to the teeth, but this also is denied. Any bad effects of this kind are due not to sugar in the diet, but to the allowing particles of sweet food to refor acid fermentation and possible injury to the teeth.

Sources of Sugar

The source of most of the sugar used until a few years ago was the sugar cane. Now over half of the sugar used in the world is obtained from the sugar beet. In 1904, only about 10 per cent of the sugar used in the United States came from the sugar beet. There has been an impression that beet root sugar is less satisfactory for many purposes than the cane sugar, but it is identical chemically. It may be true in some cases that the beet root sugar has not been completely purified, and that these impurities give an odor to the sugar upon boiling, and possibly affect some of its uses; but the properly prepared sugar may be used in every way that sugar from the sugar cane may; indeed, it is impossible to distinguish between them.

Glucose

Another sugar of which we hear a good deal is glucose. This has been made much of as an adulterant, particularly of candy. There is, however, no reason to think that glucose is less digestible or less

easily assimilated than cane sugar. Indeed, it is more nearly ready for assimilation. When we boil sugar for any length of time in the presence of an acid, we change a certain amount of the sugar into glucose. Candy that will stretch we may be sure contains at least some of its sugar in this form. If glucose is pure and properly prepared there is no reason to fear it as an adulterant of candy. The cheap coloring matter and flavors that are used in some of the cheap candies are more to be feared, since some of them are harmful.

It is possible that since glucose goes so rapidly into circulation it may overload the system more readily than would plain sugar, and it is more easily fermented.

Maple sugar, regarded as a delicacy, is simply cane sugar plus the flavoring matters found in the maple tree. Milk sugar is generally considered the most easily digested form of sugar and it less easily undergoes fermentation.

Maple Sugar

Cane sugar is on the market in various forms. Ordinary powdered sugar is, of course, the same substance as granulated sugar, but more finely ground. This is often considered adulterated because it is less sweet than the granulated form, but the lack of sweetness is due to the finely divided condition. A very simple test will serve to show the presence of adulterants since these would probably be either some form of porcelain clay, or starch. If the sugar dissolves in water neither of these can be present.

Powdered Sugar

The brown sugars that we use are simply cane sugar that has not been decolorized, or has been only partially so treated.

Molasses

Molasses formerly was obtained as a bi-product in the manufacture of sugar, and was the part of the sugar-cane juice that would not crystallize, containing a large per cent of glucose. With modern methods of work and with the coming in of beet sugar, whose molasses has such a strong flavor that it cannot be put upon the market, a manufactured molasses came into use. The commercial molasses of the present day is frequently glucose, prepared from starch, colored and flavored with a small amount of molasses from the sugar factories. Sometimes the light molasses has been bleached, and the bleaching agents, unless completely removed, may be injurious. Sorghum molasses is also used in some sections.

Effect on Diet of Use of Sugar

One comparison in regard to the addition of sugar to the diet may be interesting. In the case of milk, it has been found that an addition of this in any large amount to the diet means a corresponding decrease in the amount of other foods used. This seems not to be true of sugar. When sugar is furnished freely in abundance, it does not decrease the use of other foods, but sometimes by adding to the flavor of these actually increases thier consumption. On the other hand, the desire for sugar often marks an inadequate diet.

FOOD AND DIETETICS

PART II

Read Carefully. The following U. S. Government Bulletins should be read in connection with this lesson: No. 34, Meat Composition and Cooking; No. 85, Fish as Food; No. 128, Eggs and their Use as Food; No. 74, Milk as Food; No. 112, Bread and the Principles of Bread Making; No. 93, Sugar as Food. These may be obtained free by addressing the Department of Agriculture, Washington, D. C. Place your name and address on the first sheet of the test. Leave space between answers. *Make your answers full and complete.*

1. What is the relative value of animal and vegetable foods?
2. What are the chief nutrient ingredients of meat? How may the presence of some of these be shown? What reasons are there for cooking meat?
3. Compare clear soup, beef broth, and beef juice as to their nutritive value.
4. What meat substitutes may be used in the daily diet, and how does their value compare with that of meat?
5. In what ways does milk satisfy the requirements of a perfect food? How does it fail?
6. What is the approximate composition of milk? Under what conditions is its free use economical?
7. Give the composition of butter. How does cooking affect its digestibility?
8. What is renovated butter? How may oleomargarine be used and how does it compare with butter in wholesomeness?
9. Describe the process of cheese making.

10. What is the food value of cheese? With what foods should it be combined?
11. What can you say of the value of the cereals as food?
12. If scales are available weigh out a portion of rice (about ¼ cup), boil, and weigh again. If the scales are not at hand, measure the rice carefully, before and after cooking. How does the composition of the cooked rice differ from that of the uncooked? Repeat the experiment with a potato and compare results.
13. Why is wheat so extensively used? What is its especial value in bread making?
14. What are the chief steps in the manufacture of flour?
15. What are the tests for a good flour? Why is a flour high in gluten desirable for bread?
16. What are the characteristics of good bread?
17. Compare the nutritive value of whole wheat and white bread. When is graham bread valuable?
18. What kinds of yeast are in common use? What are the advantages and disadvantages of each?
19. State the chief changes that take place in the process of bread making and baking.
20. What is the value of sugar as food? How does beet sugar differ from that obtained from the cane? What can you say of the adulteration of sugar?
21. Ask one or more questions on this lesson.

Note.—After completing the test, sign your full name.

FOOD AND DIETETICS

PART III

VEGETABLES

An increasing importance is coming to be attached to the use of vegetables and fruits in the diet. Not only vegetarians but many others have found from experience that it is possible to live largely upon vegetable food, while those who use meat freely lay great stress upon the vegetable accompaniments whether in the form of salads or of cooked vegetables.

Botannical Classification

A study of vegetables from the standpoint of botany would imply their classification according to the parts of the plant used; whether leaf, as in the case of lettuce, cabbage, spinach; stem, as in celery, asparagus, potato (a tuber, or underground stem); root, as in beet, carrot and sweet potato; flower, as cauliflower; or fruit, as squash, cucumber, tomato.

Flavor Classification

From the standpoint of cookery the most important classification is that of *strong flavored* and *sweet flavored* vegetables, since this modifies our method of cooking; right methods leading us to retain all the juices of the latter as far as possible, while we legitimately discard part of the extract of the former. For example, green peas and string beans, young carrots, and squash, should be cooked in a small amount of water, or have the water in which they are cooked concentrated at the end so that it may all be served

with the vegetable; while in the case of onions we may well use a large portion of water, and throw it away. It is true that in this latter case we may lose valuable salts and some nutriment, but these we sacrifice for the sake of improved flavor.

Nutritive Classification

From the standpoint of diet a better classification would be into *nutritive vegetables* and *flavor vegetables*. With the latter we should include those that contain mineral salts, but have little food value. Of this class, lettuce, spinach, cabbage, tomato and cucumber are types; while rice, potatoes, peas, beans and lentils furnish examples of the former. Many vegetables will be on the border line between the two.

The composition of vegetables varies in general from that of animal foods in that here we have the carbohydrates largely represented. The chief carbohydrates of vegetables are starch, sugar, and cellulose of various types.

Cellulose of Vegetables

The fact that cellulose forms the framework of the plant and that it is within cellulose walls that the starch as well as the proteid of the plant are contained, is important in two ways. While cellulose is only slightly digested by human beings (only so little of it in young and tender plants really serving as a food that the amount may be neglected), it does have a more or less important function in furnishing the required bulk of food. If one undertakes to live wholly upon a vegetable diet, this bulk generally becomes too great; on the other hand, one of the objec-

tions to an exclusively animal diet is in the absence of bulk. Since the digestive juices do not act upon cellulose to any extent, and the nutritive portions of the vegetables are enclosed within walls of this sub-

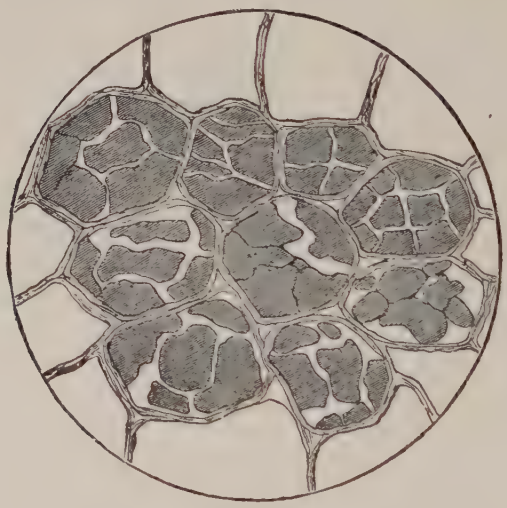
STARCH OF A POTATO ENCLOSED IN CELULOSE CELLS.

stance, the province of cooking is to so change the cell wall that the nutritive materials may be set free, or the digestive juices penetrate to them.

Effect of Cooking on Cellulose

We usually speak of softening the cellulose by means of cooking. Apparently what we really do is to dissolve the intercellular substances that bind the walls together, and thus make it possible for the cell walls

to be mechanically ruptured, either in the process of cookery or by the pressure exerted in the mouth. Part at least of this intercellular substance belongs to the pectin group that causes the jelling of fruit juices.

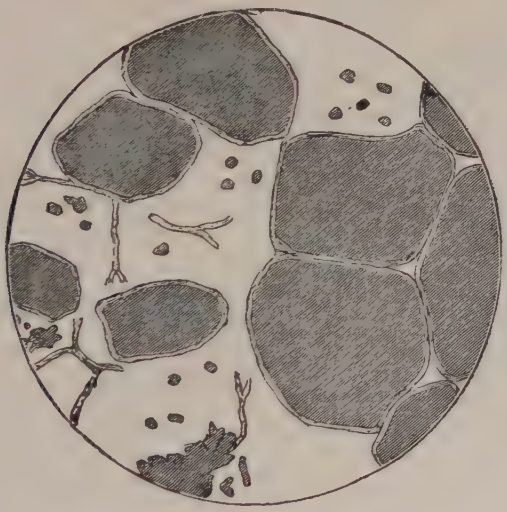


SWELLING OF THE STARCH.

Hydration of the Starch

The first process in rendering the starch of the vegetable digestible is one of hydration. It is important, therefore, that an abundance of water be present when starch is cooked. Some vegetables like the potato contain so much water that the necessary amount for the starch is supplied within the vegetable itself. The

grains and other dry vegetables need to have a large amount supplied. The swelling of the starch grains upon hydration is probably an important agent in the rupturing of the cellulose cell wall already referred to.



THE CELL WALLS RUPTURED.

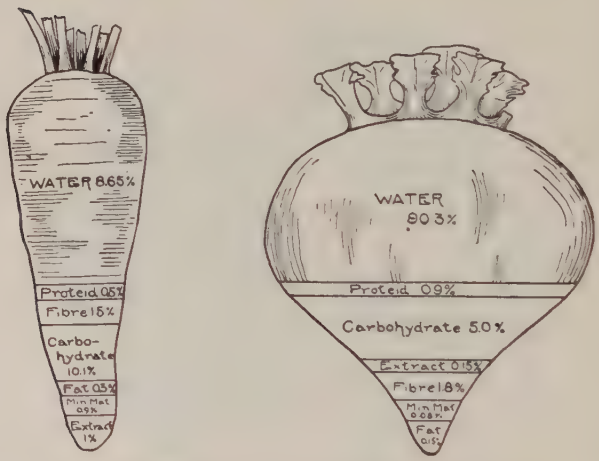
Sugar in Vegetables

Sugar is the soluble carbohydrate of the vegetable, as starch is the insoluble form in which this nutriment is stored. Some vegetables, such as carrots, show large amounts of sugar, while starch is absent from this part of the plant. Other typical vegetables containing a large amount of sugar are beets, pars-

nips, artichokes, sweet potato. Onions, cabbage, and some varieties of peas, string beans, squash and sweet corn all contain a fair amount.

Starchy Vegetables

Vegetables containing a large amount of starch are



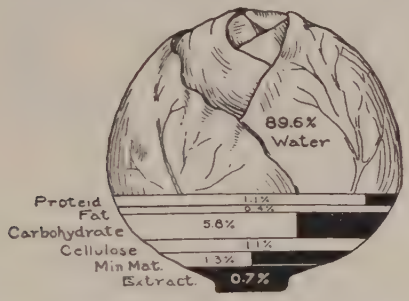
COMPOSITION OF THE CARROT AND TURNIP.
(After Hutchison)

represented by potato, sweet potato, rice, peas, beans and lentils. Some vegetables containing a large amount of cellulose are squash, potato, beet, celery, cabbage.

Proteid of Vegetables

As a rule, we do not look to the vegetable world for our main supply of proteid, yet some of our vegetables, notably the legumes, do contain an abundant

supply of this food principle. Whether this is as available for use in the body as the proteid in meat is often questioned. With ordinary cooking processes it evidently is not, but with long continued heat the matter is different. That there is no inherent difference between vegetable and animal proteid, so far as

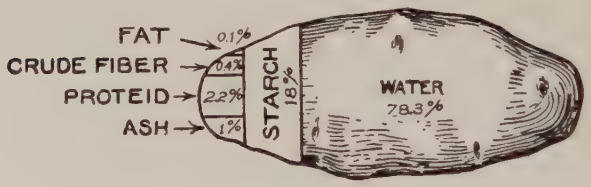


COMPOSITION OF THE CABBAGE.
Blackened portions represent amount dissolved in cooking.

Digestibility of Vegetable Proteid

its digestibility is concerned, would seem to be indicated by the fact that when the vegetable is finely divided, as in the case of some of the vegetable meals, it is absorbed to a greater extent than in its ordinary form. It is said, for instance, that when lentils are soaked and boiled until soft, 60 per cent of their proteid is absorbed, while in the lentil meal 90 per cent is utilized by the body. No careful experiments have been made to see what proportion of the boiled lentils would have been absorbed if the cooking had been continued for several hours. There is every reason,

however, to think that the percentage would be increased. Anyone who has compared dry peas or beans cooked two hours, or until they have just become soft, with those cooked from eight to twelve hours will realize the difference in the result.



COMPOSITION OF THE POTATO.

The Potato

Among the vegetables, the potato, in this country at least, is the most generally used. It has of late been decried as having no food value. This is far from true. It has, of course, a small amount of proteid, some of which is lost in the process of cooking. Its mineral salts are less in amount than in many vegetables, and are partially lost in the cooking. Its chief value as food lies in the starch it contains, and in the fact that its very absence of strong flavor makes it acceptable day after day.

Salts of Vegetables

Vegetables should be in our diet not only for their food value but for their mineral salts as well. The bad effect of the failure to use a certain proportion of vegetables and fruits, has long been known. Scurvy has usually been attributed to this error in diet, while it is quite possible that some minor disorders of the

digestion are attributable to the same cause. Cabbage, lettuce, celery, onion, spinach and the different leaves used as greens find their value almost wholly in the presence of mineral salts.

Mushrooms have often been considered of great value, from the proteid they contain, but it seems certain now that this value has been much exaggerated,

Mushrooms

SECTION OF A POTATO.

a—Outer Skin. *b*—Inner Skin or Fibro-vascular Layer. *c*—Flesh. *d*—Inner Flesh.

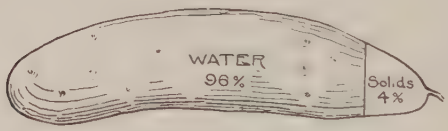
and that the reason for using them as articles of food lies in their pleasant flavor and the variety they give, rather than in the amount of nutriment they furnish the system.

Digestibility of Vegetables

The digestibility of different vegetables must always be difficult to ascertain, so far as any one individual is concerned. Not only the presence of cellulose, but

of acids, as in the tomato, of nitrogeneous substances, such as asparagin found in asparagus, and of volatile flavors, as in the onion, all affect this question.

There has been within a few years a great gain in the abundance and variety of vegetables available. Formerly in winter choice was confined to cabbage,



COMPOSITION OF THE CUCUMBER.

turnip, squash, onions and a few others. Now a visit to the market of a large city, even at the least promising time of year, shows an overwhelming variety of fresh vegetables. If we add to these the numerous canned vegetables of excellent quality available (and these are increasing in variety constantly) and the dried vegetables, like the peas, beans and mushrooms even, that are obtainable, we have no excuse for limiting our diet so far as vegetables are concerned.

True economy will consist not in cutting down the supply but in choosing fresh vegetables at the time when each is most abundant and therefore cheapest, and presumably at its best, and in supplementing these by the judicious use of the canned or dried product, not forgetting the ordinary winter vegetables.

Average Composition of Vegetables

Name	Refuse	Percentage Composition of Edible Portion						
		Water	*Carbohydrates	Fiber	Nitrogenous	Fats	Ash	†Calories, per lb.
Beans, dried	.....	12.6	55.2	4.4	22.5	1.8	3.5	1,605
Beans, string	7.0	89.2	5.5	1.9	2.3	.3	.8	195
Peas, dried	.....	9.5	57.5	4.5	24.6	1.0	2.9	1,655
Peas, green	45 0	74.6	15.2	1.7	7.0	.5	1.0	465
Potatoes	20.0	78.3	18.0	.4	2.2	.1	1.0	385
Sweet Potatoes	20.0	69.0	26.1	1.3	1.8	.7	1.1	570
Sweet Corn	61 0	75 4	19.2	.5	3.1	1.1	.7	470
Parsnips	20.0	83.0	11.0	2.5	1.6	.5	1.4	300
Carrots	20.0	88.2	8.2	1.1	1.1	.4	1.0	210
Beets	20.0	87.5	8.8	.9	1.6	.1	1.1	215
Turnips	30.0	89.6	6.8	1.3	1.3	.2	.8	185
Onions	10.0	87.6	9.1	.8	1.6	.3	.6	225
Cabbage	15.0	91.5	4.5	1.1	1.6	.3	1.0	145
Spinach	.....	92.3	2.3	.9	2.1	.3	2.1	110
Squash	50.0	88.3	8.2	.8	1.4	.5	.8	215
Tomatoes	.....	94.3	3.3	.8	.9	.4	.5	105
Lettuce	15.0	94.7	2.2	.9	1.2	.3	.7	90
Celery	20.0	94.5	2.3	1.0	1.1	.1	1.0	85
Cucumbers	15.0	95.4	2.4	.5	.8	.2	.7	80

*Not including fiber.
†Including fiber and thus higher than fuel value available in the body.

The substances grouped under carbohydrates in the above table are chiefly starch, sugar and pectose bodies. Church states that turnips contain no starch or sugar, only pectose, but one of the analyses of the Department of Agriculture showed one sample to contain over 4% of sugar. The carrot contains sugar and pectose, but no starch; parsnips, sugar, starch and pectose. The nitrogenous matter is only in part proteid; in potatoes about 57%; in carrots, onions, cabbage, cucumbers, lettuce, about one-half.

FRUITS

Classification of Fruits

Fruits may, like vegetables, be classified as *flavor* fruits and *food* fruits, and again these two classes will run together so that we shall have difficulty in deciding where certain ones belong. The apple, the orange, the strawberry, although all having a certain food value, are used so largely for their flavor and to give variety, that these may well be put under the head of the flavor fruits. Bananas form, perhaps, the best common example of the food fruits. Bread fruit, so largely used in the tropics, is another representative of this class.

Dietetic Value

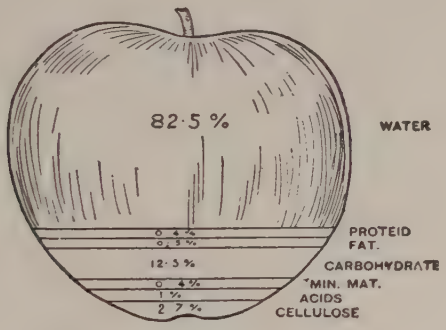
From a dietetic standpoint the most important function of fruits is that of furnishing mineral salts and organic acids to the body. The potash salts are considered especially important. Some fruits, like the pineapple, contain ferments that are said to be aids to digestion. Fruits are generally laxative in effect,—apples, figs, prunes, peaches and berries are particularly effective in this respect, especially if taken between meals or at the beginning of a meal.

Nutritive Value

Their chief nutritive value is given to fruits by the carbohydrate group. This is largely in the form of sugar, while the remainder consists chiefly of vegetable gums, among which may be included the "pectin bodies" that give to fruits their power to form jelly. Starch may be present in unripe fruits, but disappears as the fruit ripens. Bananas, as we use them, contain a small amount of starch. Of fresh fruits very few contain more than one per cent of nitrogenous matter, not all of which is proteid.

Dried Fruits

Dried fruits may be without question put under the food fruits, dates containing sixty-six per cent of carbohydrate, prunes approximately the same amount, figs about sixty-three per cent, while raisins furnish seventy-five per cent. Raisins in this respect stand almost at the head of the list of concentrated foods since they furnish so much nutriment in so small a



COMPOSITION OF AN APPLE.
(After Hutchison.)

bulk. When fresh fruits are not obtainable dried fruits may well take their place. These are usually less expensive than fresh fruits, and properly cooked go far to make up for the absence of the fresh varieties.

Canned Fruits

Canned fruits are increasingly used, and many who formerly thought it necessary to put up large amounts of fruit at home, are now purchasing those canned on a commercial scale. Whether this is a wise thing or

not depends on the amount of fruit available for the housekeeper at a low cost, the price of sugar, and the time and strength at her disposal. Often the fruit commercially canned is really superior to that prepared at home for the reason that the canning is done where the fruit is easily obtainable in its freshest and most perfect condition. When canned fruit is as reasonable in cost as it is at present, the housekeeper should certainly be very sure that her time cannot be used to better advantage before she undertakes to prepare quantities of fruit at home.

Perhaps no article of diet has increased in use during the last few years so rapidly as fruits. Not only the most hardy, but the more perishable varieties, including berries, are by improved methods of transportation, by the use of refrigerator cars and by increased areas of cultivation made available through a longer season, and at greater distances from the source of supply than ever before. The fruit industries, including the cultivation of the fruit, the great canning and drying establishments, and the transportation of the product, have become of immense importance in the commercial world.

New Varieties

New varieties of fruit produced by careful selection and cross fertilization are constantly appearing. Some of the most important changes that have been induced by cultivation have been the lessening of the proportion of cellulose, the production of seedless varieties, the increase in size and the development of fine flavors.

PICKING AND DRYING RAISINS IN CALIFORNIA
From Year Book U. S. Department of Agriculture, 1904

As in the case of vegetables, the digestibility of fruits is largely an individual matter. Bananas may be eaten freely by many, even by children, while others fail to digest even a small portion. Strawberries, generally considered easily digested, are actual poison to some people. The chief benefit of a table of digestibility is as a guide for experimentation. In feeding a child, for instance, one would try first the fruits considered most digestible.

Digestibility of Fruits

Aside from the personal equation, ease in mastication is one of the important elements in the digestion of fruits, as in the case of other foods. The banana, for instance, easily slips down the throat in large pieces; the blueberry can be swallowed whole, while such a fruit as the apple is naturally more thoroughly masticated, for ease in swallowing, and the orange almost falls apart of itself.

The difference in the digestibility of ripe and unripe fruits is generally attributed to the larger proportion of cellulose in the latter; this and the excess of acids in unripe varieties is held responsible for their ill effects.

Gilman Thomson gives among the commoner fruits easy of digestion: grapes, oranges, lemons, cooked apples, figs, peaches, strawberries and raspberries; while he classifies as somewhat less digestible: melons, prunes, raw apples, pears, apricots, bananas and fresh currants. Dried currants and citron he considers "wholly indigestible," while he gives as the most use-

ful fruits for invalids: lemons, oranges, baked apples, stewed prunes, grapes, banana meal.

Young children and those of delicate digestion should avoid all skin and seeds of fruit.

Average Composition of Fruits

	Refuse	Percentage Composition of Edible Portion						
		Water	*Corbohydrates	Fiber	Nitrogenous	Fats	Ash	†Calories, per lb.
Bananas	35.	75.3	21.0	1.0	1.3	.6	.8	460
Grapes	25.	77.4	14.9	4.3	1.3	1.6	.5	450
Plums	5.	78.4	20.1	?	1.0	.....	.5	395
Cherries	5.	80.9	16.5	.2	1.0	.8	.6	365
Huckle berries	.....	81.9	16.6	?	.6	.6	.3	345
Apples	25.	84.6	13.0	1.2	.4	.5	.3	290
Pears	10.	84.4	11.4	2.7	.6	5	.4	295
Black berries	.....	86.3	8.4	2.5	1.3	1.0	.5	270
Apricots	6.	85.0	13.4	?	1.1	.....	.5	270
Peaches	6.	85.0	10.5	?	.5	.....	6	.....
Oranges	27.	86.9	11.6	?	.8	.2	.5	240
Raspberries (red)	?	85.8	9.7	2.9	1.0	.....	.6	255
Cranberries	.....	88.9	8.4	1.5	.4	.6	.2	215
Lemons	30.	89.3	7.4	1.1	1.0	.7	.5	205
Pineapple	.....	89.3	9.3	.4	.4	.3	3	200
Muskmellon	50.	89.5	7.2	2.1	.6	.....	.6	185
Strawberries	5.	90.4	6.0	1.4	1.0	.6	.6	180
Watermelon	60.	92.4	6.7	?	.4	.2	.3	140

* Not including fiber.
† Including fiber.

The carbohydrates of fruits are chiefly in the form of sugar. Nearly all contain pectin bodies and these are most abundant in unripe fruit. The acids of the fruits are here included under the carbohydrates. Apples, pears and peaches contain malic acid; lemons and oranges, citric acid; grapes, tartaric acid; rhubarb, oxalic acid, etc.

Average Composition of Dried Fruits

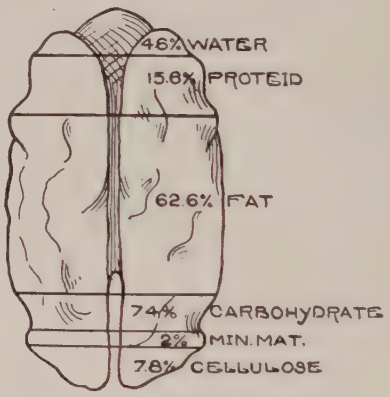
	Refuse	Percentage Composition of Edible Portion					
		Water	*Carbohydrate	Nitrogenous	Fats	Ash	*Calories, per lb.
Dates	10.0	15.4	78.4	2.1	2.8	1.3	1,615
Raisins	10.0	14.6	76.1	2.6	3.3	3.4	1,605
Currants	.....	17.2	74.2	2.4	1.7	4.5	1,495
Figs	.....	18.8	74.2	4.3	.3	2.4	1,475
Prunes	15.0	22.3	73.3	2.1	.....	2.3	1,400
Apples	.....	28.1	66.1	1.6	2.2	2.1	1,350
Apricots	.....	29.4	62.5	4.7	1.0	2.4	1,290

* Including fiber.

NUTS

Nutritive Value

The form of fruits that we know as nuts has a very different place in diet from that of the ordinary fruit. We find here foods having a nutritive value that compares favorably with that of the most nutritious substances. Almond kernels for instance contain twenty-one per cent of proteid, fifty-four of fat, and seventeen



COMPOSITION OF AN ENGLISH WALNUT.

of carbohydrates, while peanuts are richer still in proteid and also contain a large amount of fat. Indeed, nuts often may well be substituted for meat, and have the advantage that they supply at the same time a certain amount of carbohydrates. Some nuts, as chestnuts, are very rich in the latter. The table given is taken from the experiment station bulletin, *Nuts as Food*, and shows the composition of some of the most common nuts.

Average Composition of Nuts

	Refuse	Percentage Composition of Edible Portion					
		Water	Protein	Fat	Carbohydrates including Fiber	Ash	Calories, per lb
Almonds	47.0	4.9	21.4	54.4	16.8	2.5	2,895
Brazil Nuts	49.4	4.7	17.4	65.0	9.6	3.3	3,120
Filberts	52.1	5.4	16.5	64.6	11.7	2.4	3,100
Hickory Nuts	62.2	3.7	15.4	67.4	11.4	2.1	3,345
Pecans	50.1	3.4	12.1	70.3	12.2	1.6	3,300
Walnuts	58.8	3.4	18.2	60.7	16.0	1.7	3,075
Chestnuts (fresh)	15.7	43.4	6.4	6.0	42.8	1.4	1,140
Butternuts	86.4	4.5	27.9	61.2	3.4	3.0	3,370
Cocoanuts	34.7	13.0	6.6	56.2	22.6	1.6	2,805
Cocoanut, shredded	.....	3.5	6.3	57.4	31.5	1.3	3,125
Pistachio	.....	4.2	22.6	54.5	15.6	3.1	3,250
Peanuts	27.0	7.4	29.8	43.5	17.1	2.2	2,610
Roasted Peanuts	32.6	1.6	30.5	49.2	16.2	2.5	2,955
Peanut Butter	.....	2.1	29.3	46.5	17.1	5.0	2,925

Digestibility of Nuts

Much has been said about the indigestibility of nuts, but this probably comes largely from the fact that nuts are most usually eaten at the end of a hearty meal after the appetite has been completely satisfied. If nuts were more often taken as a substitute for a part of the meat of the meal, there would probably be less difficulty with regard to their digestion. Another important factor in their digestibility as in the case of other foods, is that of their finely divided condition; often they are insufficiently masticated. Some of the nut meals and pastes on the market are valuable because of their fine division, and their use as a meat substitute certainly has a rational basis. Peanut butter is the most common of these preparations.

TEA, COFFEE AND COCOA

The common beverages, tea, coffee and cocoa, are in such general use today that it is difficult to realize that two of them were not introduced into Europe until the seventeenth century, and the other only a hundred years earlier, though other nations had known them long before. Tea drinking began in Japan in 692 A. D., while coffee, though not known to the Greeks and Romans, had been used in Abyssinia and Ethiopia from time immemorial.

Varieties of Tea

The tea plant seems to be a native of Assam, a province of Burmah, but it has been grown in China and Japan for fifteen hundred years. Two different types of the plant are illustrated by the Assamese and Chinese varieties. The tea of Assam grows luxuriantly, but is sensitive to drought, cold or winds. Its leaves are of bright green, sometimes reaching a size of nine inches in length and three in width, while the young leaf is of soft texture and golden color. It may produce as many as twenty "flushes," or successive crops of young leaf during each picking season. The Chinese plant is tough and hardy, able to endure severities of climate, and to grow in poor soil with deficient moisture. The leaf is smaller, tougher and darker than that of the Assam tea plant. Between these two extremes exist all varieties of tea. Most varieties produce three or four crops a year.

The tea plant produces small white flowers which eventually yield the seed from which cultivated tea is

raised. In cultivating the plant an effort is made to produce abundant young leaf, since good tea is made from this alone. Pekoe tea is the choicest variety. The undeveloped bud at the end of a young shoot is

Pekoe Tea

TEA LEAVES.

a—Flowery Pekoe. *b*—Orange Pekoe. *c*—Pekoe. *d*—Souchong (first). *e*—Souchong (second). *f*—Congou. *H*—Bohea.

called the pekoe tip, or flowery pekoe. It is said that this tea rarely comes to this country. From it is made Mandarin tea, that commands a very high price in its native country. The next leaves produce orange pekoe and pekoe. Souchong is the next larger leaf and Congou the next. A still larger leaf formerly on the market more generally than now yields Bohea.

Souchong Tea

Black and Green Tea

All of these different varieties may be made either into black or green tea, though some plants yield leaves better adapted for the manufacture of black tea, and some that serve better for green. Japan tea, for example, is usually made into green, while the Indian are generally black. Chinese tea provides both varieties. The difference between black and green tea is, however, in the method of preparation. Green tea is prepared by withering the leaves in iron vessels over a quick fire, or by steaming them on mats. The leaf is then rolled in order to break up the tissue containing the essential oil. It is then re-heated and subjected to long continued drying over a low fire. In black tea the fresh leaf is spread out to wilt in the sun, then rolled, spread out thinly, moistened and allowed to ferment. The leaves are then dried and fired in a furnace or over a charcoal fire.

Fermentation Process

The chief difference between the black and green tea lies in this fermentation process. By this means, some of the tannic acid in the leaves is changed so that it becomes less soluble. The black tea is thus less astringent than the green. Common varieties of green tea are hyson, corresponding to the pekoe or souchong, and gunpowder, corresponding to congou.

Names

Aside from the varieties given by the stage of growth at which the leaf is plucked and by the method of preparation, teas are named from the different countries or the special district that produces them, or even from the gardens where they are grown.

Japan, Chinese, Indian and Ceylon teas each have their own marked characteristics, while the different districts of China give various kinds, as the oolongs from Formosa or the monings from north China.

Quality

The quality is dependent on the cultivation of the plant, the age of the leaf, and the care in manufacture. Some of the finest tea of China is so high priced that it can be purchased there only by the very rich, while the lowest grades are often made into bricks (brick tea) and sent into the interior. The choicest Japan tea is raised under protection from direct sunlight and is prepared without rolling. It is said to be untouched with the hand after it is put upon the steaming apparatus. Most of the teas sent to the United States might be classed as low middling, with some superior grades. The choice varieties are rarely received.

Composition

The most important constituents of tea are theine, or caffeine, tannic acid and the volatile oil that gives the flavor. Black and green tea contain practically the same amount of oil and caffeine, but black tea has only about half as much tannic acid as green.

Method of Making

The method of making tea has an important influence on the constituents of the beverage. Methods vary all the way from one Japanese fashion of stirring the finely ground tea into warm water and drinking the whole infusion, to the Russian method of bringing the water just to a boil and making a delicate infusion.

The boiling of tea and the practice of keeping the

teapot on the stove all day that the brew may be ready at any moment, each results in extracting the largest possible amount of tannic acid from the tea. If tea must stand after making, it should be poured off the leaves immediately. The difference in extract can be easily seen if equal amounts of tea be in one case boiled four or five minutes, in another allowed to stand in cold water, and in a third infused in hot water for the same length of time. If these three results be put into glasses, the depth of color will indicate the difference in material extracted. If a solution of ordinary copperas be made, and a few drops of this added to each, a black, inky substance, a tannate of iron, will form, the amount varying with the tannic acid extracted.

Adulteration of Tea

Adulterations of tea are much less common than formerly. The chief fraud practiced is that of substituting an inferior grade for a better. One method of doing this is by facing the tea. This is practiced especially on green teas, giving them a brighter color.

Occasionally spent or exhausted leaves are mixed with fresh ones, thus constituting an adulteration.

Tea tablets are sometimes prepared for the use of travelers by pressing finely ground tea of varying quality into tablets to be dissolved in hot water.

COFFEE

The coffee tree (caffaea arabica) belongs to the same botanical family as the tiny partridge berry found in our northern woods, the familiar button bush of the country roadside, and the gardenia.

COFFEE BEANS AND BLOSSOMS.

Native Home

It is native to Abyssinia, western Africa, and perhaps western Arabia, though it has now been naturalized in a large number of tropical countries. It blooms eight months in the year and with its small fragrant, white blossoms in the axils of the glossy

evergreen leaves, it presents an attractive appearance. The ripe coffee berry is dark in color and is a pulpy fruit, somewhat resembling a cherry. The berries have two cells, each containing a single seed, the coffee bean. Three gatherings of coffee are generally made annually. The ripe fruit is dried and then freed from skin and pulp, usually by machinery.

In the east a decoction is frequently made of the unroasted seeds, while in some places the leaf of the tree is used for preparing a drink; and it is said that in the Sultan's coffee the dried pulp of the berry is employed.

Roasting

The roasting of coffee so generally practiced, is chiefly for the purpose of developing its flavor and rendering the beans brittle so that they can be more easily ground, though it has other effects also. Coffee is imported from Mocha, Java, Ceylon, Maracaibo, Porto Rico, and other countries. But 75 per cent of that used in this country comes from Brazil. Our Mocha and Java mixtures are simply different kinds of berries from the same plant.

Preparation

Coffee, unlike tea, may properly be prepared either as an infusion or a decoction; that is, it may be extracted without boiling, or it may be boiled.

Constituents

The important constituents of coffee are caffeine and caffetannic acid, and caffeol, the oil that gives the fragrant aroma and flavor. Caffeol is developed by the process of roasting while the amount of caffeine is lessened. Sugar is present in considerable amounts,

PICKING COFFEE BERRIES.

and most of this is caramelized in the roasting. Fat also is found, sometimes to as much as 15 per cent, and proteid to about 10 per cent. A comparison of the composition of tea and coffee is given below:

Percentage Composition of Coffee

	Raw.	Roasted.
Moisture	8.98	0.63
Caffeine	1.08	0.82
Saccharine matter	9.55	0.43
Caffeic acid	8.46	4.74
Alcoholic extract	6.90	14.14
Fat and oil	12.60	13.59
Lugumin and albumen	9.87	11.23
Dextrin	0.87	1.24
Cellulose and insoluble coloring matter	37.95	48.62
Ash	3.74	4.56

Percentage Composition of Tea

	Unprepared Leaves.	Green Tea.	Black Tea.
Caffeine or theine	3.30	3.20	3.30
Ether extract	6.49	5.52	5.82
Hot-water extract	50.97	53.74	47.23
Tannin (as gallotannic acid)	12.91	10.64	4.89
Other nitrogen-free extract	27.86	31.43	35.39
Crude protein	37.33	37.43	38.90
Crude fibre	10.44	10.06	10.07
Ash	4.97	4.92	4.93
Nitrogen	5.97	5.99	6.22

Composition of Decoctions

This does not give a fair estimate of the composition of the drinks since we use more coffee to the cup

COFFEE BERRY AND LEAF, NATURAL SIZE
From Bulletin No. 25, Division of Botany U. S. Department of Agriculture

DRYING COFFEE IF PORTO RICO

From Bulletin No. 25, Division of Botany, U. S. Department of Agriculture

than tea. Hutchison finds that a cup of black coffee contains nearly the same amount of caffeine and tannin as a cup of tea. This depends, of course, very largely upon the methods of preparation. It is generally considered that with our ordinary methods that less tannin is present in coffee than in tea.

Adulterants

The adulterants of coffee are many. One of the commonest is chicory. In France this is often used in order to add a desired flavor. Other adulterants that have been found are roasted peas, beans, wheat, brown bread, charcoal, red slate, and dried pellets consisting of ground peas, pea hulls and cereals held together with molasses. These are met with only in ground coffee. Although at one time artificial coffee beans were manufactured to some extent, they are said to be seldom found today. The adulteration of unground coffee consists rather of the substitution or admixture of cheap or inferior varieties. A simple rough test for the detection of adulteration in coffee consists in shaking some of the sample in cold water. The pure coffee usually floats on the surface while most of the adulterants sink, the grains of chicory coloring the water a brownish red as they fall. Sometimes adulteration can be detected if ground coffee is spread out upon a paper and examined with a magnifying glass. A better protection is afforded, however, by purchasing the coffee unground.

It is said that "the earliest intimation of the introduction of cocoa into England is found in the announcement in the Public Advertiser of Tuesday, 16th June, 1657 (more than a hundred and thirty years after its introduction into Spain), stating that "in Bishopgate street, in Queen's Head alley, at a Frenchman's house, is an excellent West India drink, called chocolate, to be sold, where you may have it ready at any time; and also unmade, at reasonable rates."

Early Use of Cocoa

In spite of this alluring advertisement, it was the beginning of the eighteenth century before chocolate became a fashionable beverage. And even as late as 1832 the consumption of cocoa was very limited, owing to a large duty that existed up to that time. Long before this it had become a great favorite in Spain as it was in Spanish Ameria. In New England a mill for the preparation of chocolate was established in 1765. The chocolate of the early Spanish days must have been somewhat different from the modern article. This is one receipt that is given: "Take a hundred cocoa kernels, two heads of Chili or long peppers, a handful of anise or orjevala, and two of mesachusil or vanille—or, instead, six Alexandria roses, powdered—two drachms of cinnamon, a dozen almonds and as many hazelnuts, a half pound of white sugar, and annotto enough to color it, and you have the king of chocolates."

Cocoa Tree

The cacao tree (theobroma cacao) from which chocolate and cocoa are obtained, is a native of tropical America. It grows to an average height of from thirteen to twenty, or even thirty feet, with a diameter of from five to ten inches. A quaint description of the appearance of the tree is given in the following

FLOWER AND FRUIT OF COCOA TREE.

words: "The cacao-tree almost all the year bears fruit of all ages, which ripens successively, but never grows on the end of little branches, as our fruits in Europe do, but along the trunk and chief boughs, which is not rare in these countries, where several trees do the like. Such an unusual appearance would seem strange in the eyes of Europeans, who have never seen anything of that kind; but, if one examines the matter a little, the philosophical reason of the dis-

position is very obvious. One may easily apprehend that if nature had placed such bulky fruit at the ends of the branches their great weight must necessarily break them, and the fruit would fall before it came to maturity."

Cocoa is raised from seed, and the tree does not bear fruit till it has reached the fifth or sixth year. It requires an abundance of air and light, but must be shaded from too much direct sun. This is accomplishd by growing large shade trees at frequent intervals in the cocoa plantation.

Cocoa Bean

The cocoa beans are the seed of the plant and lie in even rows in a pod not very unlike a large cucumber in shape and size. The first step in the preparation of cocoa is the removal of the bean from this pod and its subjection to a "sweating" or fermentation process. After this the beans are dried in the sun and in this form are shipped to our market.

Beans from different places, Caracas, Trinidad, Maracaibo, Java, and others are imported by the manufacturer who mixes them in different proportions in order to get the result desired. The second step in the process of manufacture is the careful roasting of the beans to develop the flavor, and the crushing or cracking of the nuts and the removal of the thin husk or shell with which the seed is covered, by winnowing. The shells are used in many places for the preparation of a drink. If they are boiled for a long time, a smooth, oily beverage with a pleasant nutty

COCOA BEANS.
Showing Fruit, Flowers and Leaf.

flavor is obtained. The cracked cocoa, or cocoa nibs, as it is called, is also used for preparing a bev-

METHOD OF GROWTH OF COCOA.

erage. A mixture of the shells and nibs gives a very satisfactory result.

The next step in the preparation of chocolate is the

grinding of the nibs and running the semi-liquid product into molds. If sugar or any flavoring is to be added, it is done at this time.

Chocolate

Cocoa in its purest form is chocolate with part of the fat removed. In order that it may stay in a powdered condition, it is necessary either to remove this oil or add some form of starchy material. Sometimes flavoring materials such as cinnamon or vanilla are also added.

Theobromine

Cocoa, like tea and coffee, contains an alkaloid called theobromine. Tannin is also present in the raw bean, but is changed during the roasting to cocoa-red which gives the color to the cocoa. A substance somewhat like the caffeol of coffee is also developed during the roasting process. Cocoa beans also contain a large amount of fat—about 50 per cent—with proteids, starch, and other substances in small amounts.

Percentage Composition of Cocoa

	Roasted Cocoa Nibs.
Water	2.72
Ash	3.32
Theobromine	1.44
Other nitrogenous substances	12.12
Crude fibre	2.64
Starch	8.07
Other nitrogen-free substances	19.57
Fat	50.12
	100.00

The food value of clear chocolate has never been questioned. Perhaps the writer of the eighteenth cen-

tury who is responsible for the following statements may have exaggerated somewhat. He says:

"In reality, if one examines the nature of chocolate a little, with respect to the constitution of aged persons, it seems as though the one was made on purpose to remedy the defects of the other, and that it is truly the panacea of old age."

"There lately died at Martinico a counsellor, about a hundred years old, who, for thirty years past, lived on nothing but chocolate and biscuit. He sometimes, indeed, had a little soup at dinner, but never any fish, flesh, or other victuals. He was, nevertheless, so vigorous and nimble that at fourscore and five he could get on horseback without stirrups."

Food Value

So good a scientist as Liebig says, however: "It is a perfect food, as wholesome as delicious. It is highly nourishing and easily digested, and is fitted to repair wasted strength, preserve health, and prolong life." A simple statement of the case is that we have in chocolate a highly concentrated food, particularly rich in fat, but containing a fair amount of the other food principles. Since it is so concentrated it demands water in abundance. So far as its digestibility is concerned, there is more question. The very presence of so much fat means that it is too rich for some people, while others can digest it with no difficulty. Hutchison tells us that so far as cocoa as a drink is concerned the food value is over-estimated, since the amount we actually use is small. This de-

pends to a large extent upon the manner in which the beverage is prepared. The milk and sugar used add appreciably to the nutriment, and if we follow Thudichum's suggestion, we shall have a beverage of high food value even if one questions its perfection in other respects. He says: "Chocolate should be served in cups and be of sufficient consistency to be eaten with a small spoon, rather than drunk. In this way it was used by the Mexicans; they also ate it with golden spoons. We have tasted the combination, and find chocolate in a red cup and saucer, to be eaten with a golden spoon, aesthetical perfection; both taste and sight are much pleased with the combination."

The possible effect upon digestion of the theobromine present has not been fully determined. It is a substance similar in character to caffeine in coffee and tea. These beverages, however, unlike cocoa, have no food value.

Physiological Effect of Tea, Coffee and Cocoa

The physiological effect upon the system of tea, coffee, and cocoa has been much discussed. Of the three, cocoa seems to have much less influence either in retarding digestion or as a stimulant, though there is reason to think that it is not without stimulating effects.

Tea has a marked influence in lessening the action of the saliva, while both tea and coffee retard digestion, the latter to a less extent than the former. This effect seems due to the tannic acid and the volatile oil. The caffeine itself favors digestion. Both tea

and coffee act as stimulants because of the caffeine present. It is this that causes them to be so effective in lessening the feeling of fatigue. Strong coffee is a powerful antidote to narcotics, and is often used where a heart stimulant is needed. Coffee and tea may, because of the tannic acid and other astringent substances present, prove irritants to the mucous membrane of the stomach. This action is greater if the stomach is empty. The stimulating effect also is greater if taken upon an empty stomach.

Personal Equation

The effects of coffee and tea seem to be influenced largely by the personal equation, and quite opposite results are produced in different persons by them; while in most people they tend to produce wakefulness, in others they are conducive to sleep. Some people can use one freely and must refrain completely from the other.

The general conclusion from experiment and observation seems to be that, taken in moderate quantities and at suitable times, they are not injurious to the healthy adult, but that those of a feeble digestion, or who are nervous, should use them in exceedingly small quantities, if at all. Of the two, coffee seems to have the least harmful effect in the majority of cases.

Cereal Coffee

On the market at present there are a large number of coffee substitutes. Some of them undoubtedly are true cereal drinks, and may be used as such, though when a large amount of food value is attributed to

them on this account, one cannot help wondering how the insoluble substances of the wheat grain can so largely be present in the drink made from the treatment of wheat kernels in water. Some of the so-called cereal coffees are said to derive their flavor from the volatile oils produced in the roasting of coffee, while others actually contain coffee.

ADULTERATION OF FOOD

Pure Food Campaign

Probably no food question has been so much discussed of late, or has appealed so generally to the public at large as that of food adulteration. Nearly all the states have passed laws providing for more or less stringent regulations, and the United States Congress has passed a national law and is considering further legislation on the same subject. Magazines and newspapers have taken up the matter; the women's clubs have enthusiastically pressed it and a vigorous "pure food" campaign has been made. This is right and proper; but, either through ignorance, or the belief that it is justifiable to do evil that good may come, many statements are made that are not only sensational in the extreme, but absolutely untrue. Others, while not absolutely wrong, convey a distinctly false impression.

False Impressions

Mrs. Abel, in a recent article, calls attention to some types of such statements by the following illustration:

"A baby has dined on a candy Easter egg and sausage, and the heading reads

DEATH FROM COAL TAR COLOR IN EASTER CANDY.

"Now sausage is not exactly an infant food and might perhaps have been held responsible for the sad result, but sausage is a trite and common thing, while chemical colors, bearing such a disagreeable name will surely catch the public eye!

"And did we not read one other day that a prominent hygienist had announced that 450,000 babies die yearly in this country of poisoned milk? Few of us had access to census reports from which to learn that this is a much larger number than die yearly from all causes under the ages of five, and perhaps fewer still saw the indignant denial of this official, and learned how a truthful and moderate statement can be distorted."

One of our most reputable city dailies is responsible for the following absurd statement in the report of a speech:

Newspaper Statements

"Dr. Wiley, chief of the national bureau of chemistry, says that nine-tenths of the deaths each year in this country are due to dyspepsia, generally caused by impure food. He declares that the tendency also is to shorten the duration of life, and cites figures to show that 2,000,000 deaths in the United States in the last ten years have been traceable largely to the use of bad food. It is the workingman, the poor man, who cannot afford to buy the higher priced articles of food, who suffers more from these conditions.

"Viewed from an economic standpoint also, the laboring man should be interested. In the report of the Kentucky state board of health for last year the statement is made that for every dollar spent in the purchase of food, 45 cents on the average is paid for adulterations."

The implication here is even worse than the actual

statement, for while "impure food" and "bad food" might include water and milk contaminated with typhoid germs, or food that has been allowed to deteriorate by bacterial action till it is in a dangerous condition, it is evident that the meaning intended to be conveyed is that these phrases mean adulterated food.

The same paper in a recent editorial makes the absolutely ungrounded charge that numerous deaths have been caused by the presence of coal tar dyes in candy. It implies that all manufacturers are actuated by greed, and that they care nothing as to the poisonous character of their materials if only they make money.

Glucose

A circular advertising a certain breakfast food, after dividing glucose into good and bad kinds, introduces the following paragraph, saying that the definition is from the dictionary. "Glucose, the trade name of a syrup obtained as an uncrystallizable residue in the manufacture of glucose proper, and containing in addition to some dextrose or glucose, also maltose, dextrine, etc. It is used as a cheap adulterant of syrups, beers, etc. Thus we learn even in this public way that there are harmless and harmful kinds of glucose."

The implication is, of course, that glucose is unfit for food, and no account is taken of the facts that maltose is a sugar perfectly wholesome and digestible, and that dextrine is always an intermediate product in the change of starch into sugar, whether this change

is induced by the action of acid as in the manufacture of commercial glucose, or by a ferment as in the change of starch into sugar by the saliva.

No good can come from exaggerated and false statements, and it is the business of every woman who has to do with the purchasing of foods to so inform herself that she shall not be misled.

Classification of Adulterants

We may classify the adulterants of foods, using the term in a broad sense, under three headings. *First,* additions or substitutions used for the sake of cheapening the product; *second,* material such as coloring matter, used either to imitate the natural product or to beautify and make more attractive some foods; *third,* preservatives. Of the first class, by far the greater number are such as affect the pocketbook and not the health. One of the common adulterants of spices, for instance, is starch, and this only means that when such a spice is used a larger amount is needed than would be the case if it were pure. Coffee to which has been added chicory or ground peas or beans, or for which has been substituted an artificial bean, cannot be said to be less wholesome because of this treatment. Cream of tartar, because of its expense, is often adulterated, but again the adulterant is usually harmless. Butterine substituted for butter means the payment on the part of the consumer of a large price for an inexpensive article; but the article consumed is in every way as digestible and wholesome as if no substitution had been made. This and

many other articles used to adulterate more expensive ones, have their own value, and if placed upon the market under their own names, might be profitably used. There is no reason to think that corn syrup, or glucose, with a flavoring of caramel is less wholesome than maple syrup, but we all justly object to having the former product labelled with the name of the latter and sold at its price.

Correct Labeling

The crusade against adulterations should then, so far as this class is concerned, be directed toward full and correct *labelling*, and against the possibility of cheap articles being branded as superior ones or sold at the price of the better article. The consumer should demand the right to receive the full equivalent for money paid, and every effort should be made, not only to have right laws passed but to see that frequent tests are made of food materials bought in the open market, and to compel manufacturers to make a correct statement of the ingredients in their wares.

On the part of the housekeeper there should be a knowledge of materials, and ability to make simple tests, while for such tests as imply technical chemical knowledge material should be sent to the board of health or other experts. Most of all, skill in interpreting labels should be cultivated. A bottle purporting to be vanilla and labelled

PURE VANILLA,

Compound

on the face of it is not vanilla, though it may not necessarily be a less wholesome article.

Coloring Matter

The second kind of materials that we have classed as adulterants—the coloring matters, are used generally to satisfy a popular demand. Everyone knows that fresh butter is seldom of the bright yellow color of that on the market, yet few people would purchase an uncolored butter. Because in June, under the best conditions, butter is yellow, we have come to regard that as the only desirable thing. The manufacturer of a certain brand of cheese a few years ago made an attempt to put an uncolored product on the market, though he had formerly used coloring. To his surprise, he could not sell his cheese. The public, accustomed to a deep orange color in that brand, said the white cheese was not "so rich," that it was made of skim milk instead of cream, and refused to accept it.

As soon as the purchasing public has a different standard of values the manufacturer will cease to color his products. He will be content to offer properly canned tomatoes, even though the color is not as brilliant as that of the fresh fruit, and will put upon the market a catsup more attractive though less bright than the modern product. He will devise methods of canning peas and beans that will change their color as little as possible, but will not "green" them to deceive a credulous public. At the same time, the dishonest manufacturer will have less opportunity to conceal the inferiority of poor goods by the addition of color.

Coal Tar Dyes

Color is also used frankly to beautify articles, as in the case of candy, and this seems legitimate when the colors are harmless, and the coloring is delicate. In this case, as in that of other uses of it, the question arises as to the possible harmful effects of the colors used. Of late the so-called coal tar dyes have been frequently employed, and perhaps because of their name much anethema has been directed against them. As a matter of fact, most of the coal tar dyes used are perfectly harmless, with absolutely no physiological effect. They are so strong in coloring power that a very minute amount is all that is necessary to give the desired result. Some of the coal tar dyes are poisonous, and should not be used, though again the fact that so small an amount is required to produce the effect is a protection. Some vegetable dyes are also poison, as well as some of the mineral dyes used before the coal tar products were available, and both of these classes have less coloring power, and so must be used in larger quantities.

That the confectioners are not all "monsters of greed" "reeking" with the desire to make money at the cost of the health and lives of an unsuspecting public, is shown by the fact that long lists of harmless and harmful colors have been made by the National Confectioners' Association, and that the same association has offered resolutions for dealers in confectioners' colors as well for manufacturers of candies, urging only the legitimate use of non-poisonous col-

ors. Legislation and public opinion should unite in forbidding the use of any harmful coloring even in minute quantities, and careful investigation should be made and lists of safe colors presented. An educated public will see no beauty in crude and vivid colors and will demand only the most delicate shades in candies and similar products, and this will mean less coloring of any kind.

Preservatives

As to the use of preservatives in food, there is an honest difference of opinion among experts. It is contended by many that in proper amounts and under proper regulation they are a desirable safe-guard, since they keep in a fresh and wholesome condition foods that would otherwise deteriorate. The amounts necessary are so small that they would seem presumably to have no effect on the users. On the other hand, the user may not be a healthy adult, but an infant or an invalid, presenting quite a different problem. In most cases a little more care would keep the food in proper condition without the resort to doubtful means.

The two sides of the case are stated as follows in the government pamphlet giving the result of the famous borax experiment.

Government Statement

"It is admitted by all who have examined the subject in a critical way, even by the users of preservatives, that in certain maximum quantities the limit of toleration is reached in each individual and positive injury is done. But it is also well recognized that

many, if not all, of the usual foods when used in large excess produce injurious results. The many cases of disease produced by overeating, or by eating improperly prepared or poorly cooked foods, or by eating at unusual times, are illustrations of this fact. Upon this basis and upon the further statement that when used in extremely small quantities the preservatives in question cannot be regarded as harmful, is founded the principal argument in favor of the use of the preservatives, aside from the fact that the foods themselves are kept in a better and more wholesome state."

Small Quantities

"It would be useless to contend that the occasional consumption of small quantities of boric acid in a sausage, in butter, or in preserved meat would produce, even upon delicate stomachs, any continuing deleterious effect which could be detected by any of the means at our disposal, but naturally it seems that this admission does not in any way justify the indiscriminate use of this preservative in food products, implying, as it would, the equal right of all other preservatives of a like character to exist in food products without restriction.

"It appears, therefore, that there is no convincing force in the argument for the use of small quantities unless it can be established that there is only a single preservative used in foods, that this preservative is used in only a few foods, that it will be consumed in extremely minute quantities, and that the foods in

which it is found are consumed at irregular intervals and in small quantities. On the other hand, the logical conclusion which seems to follow from the data at our disposal is that boric acid and equivalent amounts of borax in certain quantities should be restricted to those cases where the necessity therefor is clearly manifest, and where it is demonstrable that other methods of food preservation are not applicable and that without the use of such a preservative the deleterious effects produced by the foods themselves, by reason of decomposition, would be far greater than could possibly come from the use of the preservative in minimum quantities. In these cases it would also follow, apparently, as a matter of public information and especially for the protection of the young, the sick, and the debilitated, that each article of food should be plainly labeled and branded in regard to the character and quantity of the preservative employed."

Conclusion

Many more experiments need to be conducted before we know the truth in the matter of preservatives. Meanwhile most careful supervision of their use should be exercised when they are allowed at all, and every effort should be directed toward securing cleanly processes of food preparation, and such good conditions that no preservatives should be needed other than the ordinary ones of salt, sugar, spices, with the processes of smoking and sterilization.

More Experiments Needed

The most common preservatives in general use are

formaldehyde, salicylic acid, benzoic acid, baking soda, borax and boric acid.

Home Tests

Some of the simpler tests for food adulterants can be successfully used by the housekeeper even without technical training.

The following methods of distinguishing between butter, oleomargarine and renovated butter are taken from the farmers' bulletin on the subject:

The Spoon Test for Butter

In the kitchen the test may be conducted as follows: Using as the source of heat an ordinary kerosene lamp, turned low and with chimney off, melt the sample to be tested (a piece the size of a small chestnut) in an ordinary tablespoon, hastening the process with a splinter of wood (for example, a match). Then, increasing the heat, bring to as brisk a boil as possible, and after the boiling has begun, stir the contents of the spoon *thoroughly*, not neglecting the outer edges, two or three times at intervals during the boiling—always shortly before the boiling ceases. In the laboratory a test tube, a spoon, or sometimes a small tin dish, is used in making this test. From the last-named utensils the test is often called the "spoon test," and sometimes the "pan test."

A gas flame, if available, can be used perhaps more conveniently than a kerosene lamp.

Oleomargarine and renovated butter boil noisily, sputtering (more or less) like a mixture of grease and water when boiled, and produce no foam, or but

very little. Renovated butter produces usually a very small amount.

Genuine butter boils usually with less noise, and *produces an abundance of foam.*

To Distinguish Oleomargarine from Genuine and Renovated Butter

Utensils Required.—The utensils required in the test to distinguish oleomargarine from renovated and genuine butters are as follows:

(1) A one-half pint tin "measuring cup," common in kitchen use, marked at the half and quarters; or a plain one-half pint tin measure, ordinary narrow form, or an ordinary small tin cup, 2¾ inches in diameter and 2 inches in height, holding about one gill and a half.

(2). A common kitchen pan, about 9½ inches in diameter at the base.

(3). A small rod of wood, of the thickness of a match and of convenient length for stirring.

(4). A clock or watch.

The Process.—The process for distinguishing oleomargarine from renovated and genuine butters is as follows:

Use sweet skimmed milk, obtained by setting fresh milk in a cool place for twelve to twenty-four hours and removing cream as fully as possible. Half fill with this milk the half-pint cup or measure, or two-thirds fill the smaller cup mentioned, measuring accu-

rately the gill of milk when possible; heat nearly to boiling, add a slightly rounded teaspoonful of the butter or butter substitute, stir with the wooden rod, and continue heating until the milk "boils up," remove at once from the heat and place in the pan (arranged while milk and fat are heating), containing pieces of ice with a very little ice water, the ice to be mostly in pieces of the size of one to two hens' eggs (not smaller, as small fragments melt too rapidly) and sufficient in quantity to cover two-thirds of the bottom of the pan; the water to be in quantity sufficient, when the cup is first placed in the pan, to reach on the outside of the cup to only one-fourth the height of the milk within; any water in excess of that amount must be removed. (This refers to the condition at the beginning of the cooling; later, as the ice melts, the water will rise to a higher level.) Stir the contents of the cup rather rapidly, with a rotary and a cross-wise motion in turn, continuously throughout the test, except during the moment of time required for each stirring of the ice and water in the pan, which must be done thoroughly once every minute by the clock. This is done by moving the cup about, in a circle, following the edge of the pan. Proceed in this manner for ten minutes, unless before that time the fat has gathered or has allowed itself to be easily gathered in a lump or a soft mass, soon hardening. If it so gathers, the sample is oleomargarine; if not, it is either genuine or renovated butter."

It will be seen that by trying both of these tests one may determine which of the three a suspected sample of butter really is.

A method of determining the presence of coal tar dyes in foods has been given in the following words by a recent writer:

Test for Aniline Colors

"Suppose that some cheap currant jelly is to be examined. Stir up about one-fourth of the contents of the tumbler of jelly with about a pint of water in an agate stewpan. Take a piece of white woolen cloth about five or six inches square and wet it thoroughly with boiling water. Care should be taken that it is "all wool," and white is better than cream color. Nun's veiling is an excellent thing to use. Immerse the cloth in the diluted jelly and boil it on the stove for five or ten minutes, stirring it frequently with a small wooden stick. Then remove it and wash well in boiling water. If a dye has been used in the jelly the cloth will be brightly colored.

"Natural colors impart to the wool, when treated in this way, only a dull pinkish-brown color, quite different from the brilliant color of the artificial dye. In order to be absolutely certain, however, it is best to take the dyed wool and boil it with about a tablespoonful of ordinary household ammonia in half a pint of water. After boiling for five minutes, remove the wool, and if the ammonia is colored add to it a third of a cupful of vinegar, immerse it in a second piece of the white woolen cloth and boil it as before. Any color that is imparted to the second piece of

cloth is the analine dye, which was dissolved off by the ammonia. The natural color would not be removed from the first cloth by the ammonia, hence would not dye on the second piece. The coloring can be boiled out of sausages and dyed on wool in the same way."

Gelatine Test

"Another interesting way of showing the presence of these dyes, especially in beverages, is to dye them on gelatine. Dissolve one part of gelatine in ten parts of boiling water and pour it into a deep pan to harden. When it is cold, by means of a sharp knife cut it into inch cubes. Place one of these cubes into the suspected liquid and allow it to remain for twenty-four hours, then wash it slightly with cold water and cut through it with a knife. If the color is a natural one it will lightly tinge the outer surface of the cube, but will not penetrate far below the surface, so that the inner portions will be largely free from color. Nearly all of the coal-tar dyes, cochineal and similar colors, will be found to permeate the jelly cube, often to the center.

"One advantage of the dyeing on cloth, however, is that the sample can be preserved as evidence. Nothing is better than ocular proof to convince the average person."

Several other tests for food adulteration have been given under the special foods or in other papers of this series. (See also Bulletin No. 100. *Some Forms of Food Adulteration and Simple Methods for Their Detection.* Price 10 cents, of the Supt. of Documents, Washington, D. C.)

SPECIAL DIET

The housekeeper of today must know not only how to select food for the normal member of her household, and how to provide for the varying needs of different ages and activity, but she is many times called upon to direct the diet of an invalid or a delicate child or to provide special foods for those who are sick.

Housekeeper's Province

It is not her province to diagnose a case, or to prescribe special diet, but it is her part to be able intelligently to carry out the directions of a physician. If the invalid is to have starchy foods eliminated from his menu, the housekeeper must know where to turn to obtain foods that will furnish the requisite number of calories without recourse to carbohydrates, and she must be able to prepare such food in a palatable manner; if the diet is to contain a large amount of fat, as in the case of a tubercular patient, she must know where to obtain this food in a digestible form, and, if there is need for economy, how to substitute cheap forms of fat for the more expensive ones. She must know, when the direction is given for a nourishing diet, how to add the egg or milk that is required, or to substitute some other form of food if these are not acceptable.

The housekeeper then, so far as invalid diet is concerned, should be familiar first, with the composition of the ordinary food materials, and second, with the relative digestibility of the different foods so far as

that knowledge is available and with their physiological effect. Then, and then only, can she intelligently carry out the directions given.

Food for Children

One of the troublesome problems for the mother is the deciding upon the right food for children, especially for those of school age. While the physician will direct her in the care of her invalids, and in the food necessary for the young baby, she is usually left to work out her own problems so far as the older child is concerned. One reason for this is that comparatively little attention has been given to this matter, while the diet for the baby has been studied for years.

Fortunately the healthy child settles the matter for himself to quite an extent and his own normal appetite guides him up to a certain point. But a normal appetite may easily become perverted, and lead him far astray.

High Proteid

As we have seen, the child needs a larger percentage of proteid in the diet than the adult. At about ten or twelve years the needs of the body rapidly increase, and a far larger amount of food in proportion to body weight is used than in the case of the adult. The mother who has a growing boy of this age is often astonished at the amount of food he eats and seems to need. The chart given on page 51 shows the proportional amounts of the different foods needed at different ages.

Little anxiety need be felt lest the child overeat if the food be *properly masticated* and so taken slowly,

if it be of the right kind, and if it be taken at proper times. The latter point is particularly important in its relation to sweets. Candy at the end of a meal for dessert is legitimate and even desirable, but the same article bought at the candy store and eaten on the way home from school before dinner is seriously objectionable, since it satisfies the appetite and lessens the desire for the regular meal without giving adequate nourishment. An over amount of sugar may easily be taken in this way while rarely, if ever, does this happen if the appetite is first largely satisfied with bread and milk, vegetables and meat.

Children's Parties

The often objectionable children's party would be robbed of its evil effects if simple, attractive sandwiches were always provided in abundance before the ice cream and cake were offered, since few children would over-eat of the latter under these circumstances.

If children are to be allowed to eat freely the food must be simple in character and easy of digestion. The ordinary meats, with the exclusion of pork, cooked simply, few "made" dishes, an abundance of vegetables and fruits, only the simplest puddings, no pastry, occasional plain cake (not between meals), plenty of the best of bread and butter, of well cooked cereals and of milk and eggs will furnish variety sufficient for anyone. Tea and coffee are to be reserved for the adult, while cocoa may be used in moderation, chiefly for the milk with which it is made. Highly seasoned foods are to be avoided, as they tend

to excite unduly the flow of the digestive juices and gradually make such flow dependent on their stimulation. Their continued use also seems to induce a craving for strong stimulants.

Fat in the Child's Diet

It is necessary to encourage many children to eat more fat than they are inclined to do. This may as legitimately be taken in the form of butter and cream as in that of fat meat, so generally repungant to children. Hutchison suggests that toffee taken at the end of the meal is a good medium for fat when there is difficulty in giving sufficient in other ways.

With young children special attention must be paid to the digestibility of the food. This is frequently a matter of personal idiosyncracy, and when this is the case the matter can only be determined by experiment. The safe way is to begin the diet with foods which are generally easily digested, and to allow those more difficult of digestion only at a later period. If any one article proves unwholesome in the particular case, it should of course be discarded.

Omniverous Tastes

On the other hand, it is most undesirable that children should grow up without learning to like all ordinary foods, and without being able to eat every kind of wholesome food. Such habit cannot be acquired unless a certain variety is provided and unless the child who is old enough be encouraged to try different articles. Even those less easily digestible may at a proper age be taken occasionally with impunity, for the sake of accomplishing this end. Vegetables,

while so desirable in the diet, often seem to be an acquired taste.

Above all things there should be no yielding to a child's whims in allowing him to refuse the food offered and to require special provision for himself.

Eating Between Meals

The question of eating between meals is one that frequently arises. During the school period there is difficulty in providing food at sufficiently short intervals. The child who has breakfasted early, often becomes exhausted before the time of the noon meal. This exhaustion sometimes is shown by the apparent stupidity or the inattention and restlessness of the child, and sometimes by extreme irritability. Wherever this interval is a long one, there should be provision for some luncheon during the morning. School lunches have been established in many places and when well conducted serve an excellent purpose. Where the establishment of such a luncheon is not possible, a light lunch carried from home, such as a sandwich, a slice of bread and butter sprinkled with sugar, or even some fruit or sweet chocolate, eaten in the middle of the morning, will do much to preserve the good temper of the child and to make it possible for him to do his work adequately. The child who at home grows hungry between meals should be allowed to have something to eat, provided it be bread and butter, a sandwich, or crackers and milk, or fruit. With the younger children the heartiest meal should be in the middle of the day, and the evening meal

should be chosen with especial reference to ease in digestion.

In general, then, the food for children should differ from that of adults, first, in being of the most simple character; second, in the absence of stimulating substances, such as large amounts of spice; third, in the proportions of the different food principles. In addition to this the child should think as little as possible about the food he eats. The constant discussion of the wholesomeness of different articles of diet and the consequent directing of the attention of the child to his own bodily processes seems distinctly harmful. Such discussion should only be used when necessary in order to show the unsuitableness of some especially desired food that must be denied. Good habits in regard to food should be established at this age, rather than theories about it.

Students' Diet

Much has been said in regard to food for older students, and a number of studies of student diet have been made. A few points only can be considered. In the first place, the student is leading a sedentary life, and does not need the hearty food required by the laborer or the one who is doing much outdoor or manual work. The proportion of proteid should be somewhat high in comparison with that of the carbohydrates, and the food should be simple and digestible, in order that but little energy be used in carrying on the processes of digestion.

A good variety is needed, however, and especial care must be exercised to make the food attractive that the appetite may be stimulated. The comparatively small amount of exercise taken generally by the student makes this especially necessary, though no amount of attention paid to the food can or should be a substitute for the healthy appetite.

As in the case of the child, it is frequently wise for the student to eat oftener than at the regular meal time. A glass of milk, a cup of cocoa, or of broth with a cracker in the middle of the morning will often prevent a headache from exhaustion.

Old Age Diet

Old age needs especial consideration in regard to diet as well as youth. After middle life the total amount of food needed lessens somewhat, and the proportion of building material, both of proteids and of mineral salts is less. Again, as in childhood, care must be exercised in regard to digestibility and simplicity of food. Often special conditions of the system must be considered and certain kinds of food avoided, but this is a matter for intelligent following of a physician's directions.

One of the question that frequently arises in regard to diet is that of reducing or increasing flesh by this means. Increase in weight implies that more food is taken into the body than is utilized in the repair of waste and in work. To prevent the storage of fat more work must be performed or less food taken. The well known systems for curing obesity depend chiefly on the reduction of the total amount of food,—some-

times to two-fifths of the standard dietary, and on the lessening of the proportion of fats and carbonydrates, especially of the latter. So radical a treatment as this should only be undertaken under the direction of a physician as there is a possibility of serious injury to health. A diminution of the sugar and starch in the diet and a slight lessening of the total amount eaten with increased light exercise may be undertaken by almost anyone with the result of decreasing the fat of the body.

The converse of course holds true. Rest, a full diet, and one rich in carbohydrate and fat tend to increase the storing of fat in the body, although there is occasionally a person who fails to respond to such treatment. In increasing the diet due regard must be paid to the digestive powers of the individual that they may not be over-taxed.

It is said that some oriental countries, wiser than we, have a custom of paying the physician for keeping the family well, not for restoring the sick member to health. In the absence of such a custom and with physicians not trained for this purpose, the housemother herself must perform this office.

Special diet in disease must be directed by the physician, for the housekeeper, even though she informs herself upon the general principles of such diet, cannot recognize special symptoms that often require individual modification of general rules. She must content herself, then, with the role of preserver of health, and though she can by no means ward off all sickness by the best planned dietary, she can do much toward strengthening the constitution of the members of her family, and making their bodies more resistant to disease.

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Story of a Grain of Wheat ($1.00, postage .10). W. C. Edgar.

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No. 63—Care of Milk on the Farm.

No. 74—Milk as Food.

No. 85—Fish as Food.

No. 93—Sugar as Food.

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No. 129—Sweet Potatoes.

No. 142—Principles of Nutrition and the Nutritive Value of Food.

No. 175—Home Manufacture and Use of Unfermented Grape Juice.

No. 182—Poultry as Food.

No. 183—Meat on the Farm: Butchering, Curing, and Keeping.

No. 203—Canned Fruit, Preserves and Jellies.

Reprint from Year Book of 1900—The Value of Potatoes as Food.

Reprint from Year Book of 1902—The Cost of Food as Related to Its Nutritive Value.

Circular No. 43—Foods, Nutrients, Food Economy.

Circular No. 46—The Functions and Uses of Food.

Also, see the List of Bulletins and Circulars of U. S. Department of Agriculture for Free Distribution, for contents of the Farmers' Bulletins called "Experimental Work," which have many brief articles of interest, compiled chiefly from State Agricultural Station reports.

STATE AGRICULTURAL EXPERIMENT STATION BULLETINS.

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Maine Agricultural Experiment Station, Orono, Maine.

Bulletin No. 54—Nuts as Food.

Bulletin No. 65—Coffee Substitutes.

Bulletin No. 84—Cereal Breakfast Foods.

Bulletin No. 118—Cereal Foods.

Illinois Agricultural Experiment Station, Urbana, Ill.

Circular No. 71—Roasting of Beef.

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Bulletin No. 230—The Cooking Quality of Potatoes.

Minnesota Agricultural Experiment Station, St. Paul, Minn.

Bulletin No. 74—Digestibility of Beans.

Bulletin No. 92—Digestibility of Cabbage, Cheese, Rice, Peas and Beans.

Note.—There are many other State bulletins but their results are usually republished in the bulletins of the Office of Experiment Stations.

FOR SALE BULLETINS OF THE OFFICE OF EXPERIMENT STATIONS.

Send coin or money order (stamps not accepted) to the Superintendent of Documents, Washington, D. C.

No. 28—The Chemical Composition of American Food Materials. By W. O. Atwater. Price 5 cents.

No. 29—Dietary Studies at the University of Tennessee in 1895. By Chas. E. Wait, Ph. D. Price 5 cents.

No. 35—Food and Nutrition Investigations in New Jersey. By Edward B. Voorhees. Price 5 cents.

No. 40—Dietary Studies in New Mexico. By Arthur Goss, M. S. Price 5 cents.

No. 43—Losses in Boiling Vegetables and the Composition and Digestibility of Potatoes and Eggs. By H. Snyder, B. S. Price 5 cents.

No. 52—Nutrition Investigations in Pittsburg, Pa. By Isabel Bevier, Ph. M. Price 5 cents.

No. 53—Nutrition Investigations at the University of Tennessee. By Chas. E. Wait, Ph. D. Price 5 cents.

No. 55—Dietary Studies in Chicago. Jane Addams and Caroline L. Hunt. Reported by W. O. Atwater. Price 5 cents.

No. 63—Description of a New Respiration Calorimeter and Experiments on the Conversion of Energy in the Human Body. By W. O. Atwater, Ph. D. Price 10 cents.

No. 84—Nutrition Investigations at the California Agricultural Experiment Station. By M. E. Jaffa, M. S. Price 5 cents.

No. 85—A Report of Investigations on the Digestibility and Nutritive Value of Bread. By Chas. D. Woods. Price 5 cents.

No. 91—Nutrition Investigations at the University of Illinois, North Dakota Agricultural College, and Lake Erie College, Ohio. By H. S. Grindley, J. L. Sammis, E. F. Ladd, Isabel Bevier, and Elizabeth C. Sprague. Price 5 cents.

No. 101—Studies on Bread and Bread Making at the University of Minnesota. By Henry Snyder, B. S. Price 5 cents.

No. 102—Experiments on Losses in Cooking Meat. By H. S. Grindley, D. Sc. Price 5 cents.

No. 107—Nutrition Investigations Among Fruitarians and Chinese at the California Agricultural Experiment Station. By M. E. Jaffa, M. S. Price 5 cents.

No. 126—Studies on the Digestibility and Nutritive Value of Bread at the University of Minnesota in 1900-1902. By Harry Snyder, B. S. Price 5 cents.

No. 129—Dietary Studies in Boston and Springfield, Mass., Philadelphia, Pa., and Chicago, Ill. By Lydia Southard, Ellen H. Richards, Susannah Usher, Bertha M. Terrill, and Amelia Shapleigh. Price 10 cents.

No. 132—Further Investigations Among Fruitarians at the California Agricultural Experiment Station. By M. E. Jaffa, M. S. Price 5 cents.

No. 141—Experiments on Losses in Cooking Meat, 1900-1903. By H. S. Grindley, D. Sc. Price 5 cents.

No. 143—Studies on the Digestibility and Nutritive Value of Bread at the Maine Agricultural Experiment Station, 1899-1903. By C. D. Woods. Price 5 cents.

No. 149—Studies of the Food of Maine Lumbermen. By C. D. Woods. Price 10 cents.

No. 152—Dietary Studies with Harvard University Students. By Edward Mallinckrodt, Jr. Price 5 cents.

No. 156—Studies of the Digestibility and Nutritive Value of Bread and of Macaroni at the University of Minnesota. By Harry Snyder, B. S. Price 10 cents.

No. 162—Studies on the Influence of Cooking upon the Nutritive Value of Meats at the University of Illinois, 1903-1904. By H. S. Grindley, Sc. D. Price 15 cents.

PURE FOOD

Circular No. 16—Officials charged with the Enforcement of Food Laws in the United States and Canada.

Circular No. 17—Standards of Purity for Food Products.

Circular No. 59—Influence of Formaldehyde on the Digestive Enzymes.

Extract No. 44—Butter Substitutes.

Extract No. 221—The Use and Abuse of Food Preservatives.

Extract No. 328—Determination of the Effect of Preservatives on Food and Health.

Extract No. 331—The Adulteration of Drugs.

Farmers' Bulletin, No. 131—Household Tests for the Detection of Oleomargarine and Renovated Butter.

Bulletin No. 13—(Bureau of Chemistry). Part 9, Cereals and Cereal Products. Price 5 cents.

Bulletin No. 13—(Bureau of Chemistry). Part 10, Preserved Meats. Price 10 cents.

Bulletin No. 84—(Bureau of Chemistry). Influence of Food Preservatives on Health, Part I Boric Acid and Borax. Price 30 cents.

Bulletin No. 60—(Bureau of Chemistry). Food and Food Control. (Revised). Parts I, II, III, IV, V, VI, VII, VIII. Price 5 cents each.

National laws to 1905 in Part I and laws of all the States in alphabetical order. Request State laws wanted.

Bulletin No. 100—(Bureau of Chemistry). Some Forms of Food Adulteration and Simple Methods for their Detection. Price 10 cents.

Bulletin No. 46—(Bureau of Animal Industry). The Milk Supply of 200 Cities and Towns. Price 15 cents.

Bulletin No. 70—(Bureau of Animal Industry). Milk Supply of 29 Southern Cities. Price 5 cents.

Bulletin No. 81—(Bureau of Animal Industry). The Milk Supply of Boston, New York, and Philadelphia. Price 5 cents.

Also, see State publications on pure food, especially bulletins and reports of North Dakota Experiment Station, Fargo, N. D.; Wyoming Agricultural Experiment Station, Laramie, Wyo.; Wisconsin Dairy and Food Commission, Madison, Wis.; Pennsylvania Dairy and Food Commission, Harrisburg, Pa.; Massachusetts State Board of Health, Boston, Mass.; Maine Agricultural Experiment Station, Orono, Me.; Nebraska Food Commission, Lincoln, Neb.; Minnesota Dairy and Food Commission, St. Paul, Minn., etc.

PERIODICALS AND LISTS.

Experiment Station Record, published by U. S. Department of Agriculture, Office of Experiment Stations. Price $1.00. Published monthly and contains extracts and summaries of national and state publications, foreign and domestic magazines, and current books relating to food and the work of the various departments.

The *Monthly List of New Publications* of the Department of Agriculture will be sent regularly to all who apply for it. (Free.)

Complete list of bulletins for free distribution and for sale will be sent on application to the Department of Agriculture, also the list food of the Office of Experiment Stations, Bureau of Chemistry, etc.

TEST QUESTIONS

The following questions constitute the "written recitation" which the regular members of the A. S. H. E. answer in writing and send in for the correction and comment of the instructor. They are intended to emphasize and fix in the memory the most important points in the lesson.

FOOD AND DIETETICS

PART III

Read Carefully. It will be advisable to read the following United States Department of Agriculture Bulletins in connection with this lesson: No. 121—Beans, Peas, and Other Legumes as Food. No. 129—Sweet Potatoes. Reprint—The Value of Potatoes as Food. Circular No 17—Standards of Purity for Food Products. Circular No. 16—Officials Charged with the Enforcement of Food Laws. Extract No. 221—Use and Abuse of Food Preservatives. *Make your answers full and complete.*

1. In what different ways may vegetables be classified? Classify the following according to each method: Tomatoes, potatoes, sweet potatoes, squash, turnips, beets, green corn, lettuce, spinach, cabbage, green peas, dried peas, string beans, dried lima beans, celery, rice.
2. How does the percentage of water in milk compare with that in vegetables and fruits?
3. How does the presence of cellulose in vegetables affect our use of them?
4. Why do vegetables have an important place in the diet?
5. Compare fruits and nuts as to food value.
6. Name three fruits that have a high food value.
7. Compare tea, coffee and cocoa as beverages.
8. Describe the process of the preparation of tea for the market, and account for the names of different kinds.
9. What are the reasons for prohibiting the adulteration of foods?
10. (a) How ought this to be accomplished? (b) What do you know of the food laws in your own state?

11. Give examples, from your own experience if possible, of misleading statements in regard to food, and show the truth in the matter.
12. Can you suggest any way in which standards may be changed so that the public will not demand such articles as colored butter?
13. Give the arguments for and against the use of preservatives. Which side seems to you to have the better case?
14. Try the two tests for distinguishing butter, butterine, and renovated butter, and report your results.
15. How should the diet of a child, say from five to ten years of age, differ from that of the adult?
16. What is the objection to the use by the child of tea, coffee and highly seasoned food?
17. What control should be exercised over eating between meals on the part of the child?
18. What is the need for fat in the child's diet? In what ways may it be supplied?
19. Make out a menu for three days for a child of about eight.
20. What is the province of the housekeeper in regard to food for the sick?
21. Summarize the chief new points that you have learned from *Food and Dietetics.*
22. To what extent and how has the study of these lessons resulted in the modification of your own diet or that of your family?
23. What questions have you?

Note.—After completing the test, sign your full name.

FOOD AND DIETETICS

NOTES ON THE QUESTIONS

The chief difficulty that our students seem to have in answering the questions seems to be in the calculations necessary in question 6 and 21 of Part I. These seem to arise chiefly from lack of practice in using percentages.

Question 6 reads: "Which would be the cheaper source of proteid, beefsteak at 22 cents per pound, milk at 7 cents per quart, bread at 5 cents per pound, corn meal at 3 cents per pound?"

As percentage simply denotes the number of parts in 100, it seems simplest in this problem to calculate the cost of 1 pound of proteid in 100 pounds of each of the materials, viz., if beef contains 19% of proteid (table page 57), 100 pounds of beef will contain 19 pounds of proteid, and

100 lbs. beef steak @ 22c. a lb. costs $22.00. Then 1 lb. proteid in beef steak will cost $22.00 ÷ 19 = $1.15 per lb.

In the same way,—

100 lbs. of milk with 3.3% proteid contains 3.3 lbs. 100 lbs. milk = 50 qts. @ 7c. a qt. costs $3.50. 1 lb. proteid in milk costs $3.50 ÷ 3.3 = $1.06 per lb.

In like manner, the cost of one pound of proteid in bread and in corn meal is obtained with little cal-

culation and the cheapest source of proteid is obvious. In the use of percentage and decimals, to avoid errors in pointing off, note whether the answer is *reasonable*.

Although Question 21 is optional, — "Calculate the amount of proteid, carbohydrates, and fat in own diet for one day as nearly as you can," a number of interesting solutions have been sent in. The following is a good example:

MENU

Breakfast		Lunch		Dinner	
Orange	3 oz.	Potato Soup		Tomato Soup	
Oatmeal	½ "	Potato	2 oz.	Butter	⅛ oz.
Cream	1½ "	Milk	4 "	Flour	⅛ "
Sugar	½ "	Butter	¼ "	Tomatoes	4 "
Toast	2 "	Flour	¼ "	Crackers	⅛ "
Butter	¼ "	Cold Beef	2 "	Beefsteak	6 "
		Bread	2 "	Potatoes	4 "
		Butter	½ "	Lettuce with Oil Dressing	
		Chocolate		Lettuce	1 oz
		Milk	3 "	Oil	¼ "
		Sugar	1 "	Bread	1 "
		Chocolate	½ "	Butter	¼ "
				Strawberries	4 "
				Cream	1 "
				Sugar	1½ "

Percentage Composition and Weight of Nutrients of Food Consumed

	Weight, Ounces	Per cent of Proteid	Ounces of Proteid	Per cent of Carbohydrate	Ounces of Carbohydrate	Per cent of Fat	Ounces of Fat
Oatmeal	½	16 7	0835	66.2	.331	7.3	.0365
Cream	3	2.5	.075	4.5	.135	18.5	.555
Orange	3	.6	.018	8.5	.255	.1	.003
Bread	5	11.9	.595	51.5	2.575	.3	.015
Butter	1⅜	1.0	.013	....	.....	85.0	1.168
Potato	6	3.6	.216	22.4	1.344	4.5	.270
Milk	7	3.3	.231	5.0	.350	4.0	.280
Flour	⅜	7.9	.029	76 4	.286	1.4	.005
Cold Beef	2	22.3	.446	....	...	28 6	.572
Chocolate	⅓	12.9	.043	30.3	.101	48.7	.162
Sugar	3	....	....	100.0	3.000	....	....
Tomato	4	.9	.036	3 9	.156	.4	.016
Crackers	⅛	9.8	.012	73.1	.091	9.1	.011
Beefsteak	6	23.9	1.434	....	....	10.2	.612
Lettuce	1	.1	.001	2.5	.025	.2	.002
Oil	¼	....	....	....	....	100.0	.250
Strawberries	4	.9	.036	7.0	.280	.6	.024
	47		3 268		8.929		3.981

Total Amount of Food Consumed During the Day

PROTEID	CARBOHYDRATE	FAT
3.268 ounces	8.929 ounces	3.981 ounces
or	or	or
92.615 grams	253.019 grams	112.821 grams

There are 28.34 grams (28⅓) in an ounce.

Fuel and Energy Value of Food Consumed

	Calories
92.615 grams proteid × 4.1 =	379.7
253.019 grams carbohydrate × 4.1 =	1,037.3
114.821 grams fat × 9.3 =	1,049.0
Total	2,466.0

Of course this involves a great deal of calculation, and no one would think of undertaking so much extra work often. As stated on page 60, the chief value of calculating a few dietaries is in giving a definite

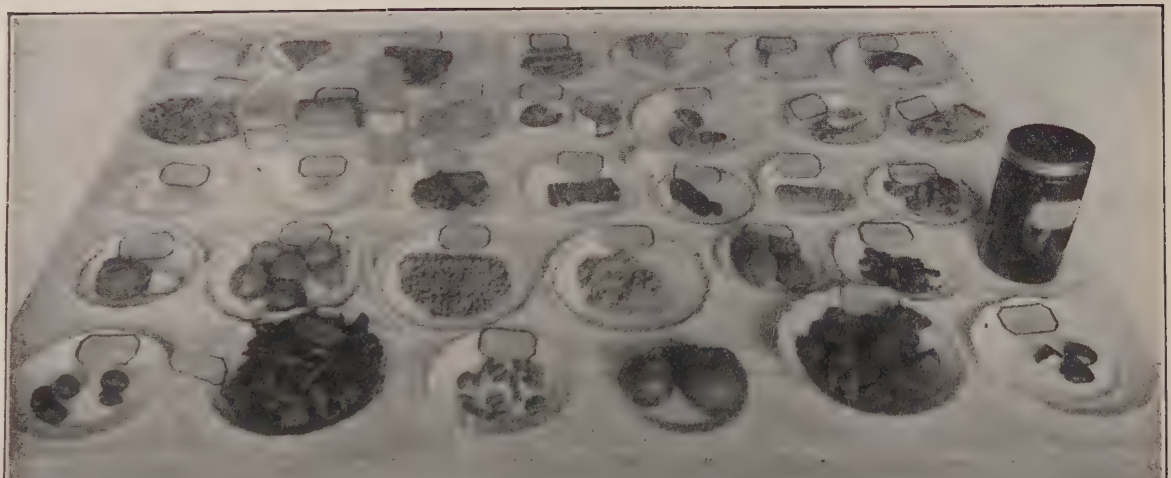
idea of the composition of food. It is not expected or necessary that each day's ration should conform to any standard. It is only when the diet is calculated for a considerable period of time that it becomes of much use for comparison.

The method of studying the diet for a month is described on page 59. When this is done, there is in reality less calculation involved, for then the figures are based on the amount of raw materials used and the composition of each individual dish need not be calculated. That is, the total weight of flour, butter, milk, eggs, and sugar is known and there only remains the allowance to be made for waste.

The whole subject of standard dietaries is in a somewhat chaotic state at present. Professor Chittenden's experiments have shown that it is possible to maintain health and strength on about half the amount of proteid recommended in the standard dietaries. If Dr. Folin's theory is correct (see following article), any ordinary diet contains more than sufficient proteid for the physiological needs of the body. Nearly all dietetians agree that, from the *physiological* standpoint, it is immaterial whether the body obtains its supply of heat and energy from fats, carbohydrates, or proteids.

But all this does not mean that a proper balance between the food materials is not necessary for health. Digestibility, bulk, personal taste and habit must

be considered. The problem, then, of the balanced ration becomes an individual one, to be solved according to the conditions and experience of each individual person. To make the best selection of foods it is necessary to know as much as possible about the composition of all ordinary foods. Then proper cooking and serving and especially the manner of eating and the amount eaten are fully as important as the composition. So there is no royal road to the selection of a *best* diet, but experience based on knowledge should give good judgment.—*M. Le Bosquet.*



DR. FISHER'S "STANDARD PORTIONS" OF COOKED FOODS

100 Food Units (Calories) Each*

Prepared at
Lewis Institute, June '08

Copyright 1909, by
American School of Home Economics
Chicago

KEY

White Bread 1.4 oz. Corn Bread 1.4 oz. Brown Bread 1.5 oz. Graham Crackers 0.82 oz. Sponge Cake 0.81 oz. Frosted Cake 0.98 oz. Doughnuts 0.8 oz.
Corn Flakes 0.95 oz. Shredded Wheat 0.94 oz. Macaroni 3.8 oz. Baked Beans 2.6 oz. Caramel Custard 2.5 oz. Macaroons 0.82 oz. Lemon Pie 1.7 oz. Apple Pie 1.3 oz.
Milk 4.8 oz. Oat Meal Mush 5.6 oz. Egg 2.1 oz.
Butter 0.41 oz. Cheese 0.77 oz. Veal Leg 2.1 oz. Fat Roast Beef 0.56 oz. Lamb Chop 0.95 oz. Bacon 0.43 oz. Canned Salmon 1.5 oz.
Baked Potato 3 oz. Beets 8.7 oz. Canned Green Peas 0.3 oz. Succotash 3.5 oz. Peaches 16 oz. Raisins (seeded) 1.0 oz. Consomme 20 oz.
Olives 1 oz. Pickles 11.6 oz. Almonds 0.65 oz. Apples 7.4 oz. Strawberries 9.1 oz. Chocolate Creams 0.9 oz.

* Data from "A Graphic Method in Pratical Dietetics" by Irving Fisher, Ph. D.

NEW METHODS IN DIET CALCULATIONS

THE ordinary method of figuring dietaries, using the tables of food by percentage composition, involves much tedious figuring so that such dietaries are very seldom calculated in practice. Although there is no settled "best diet" for human beings applicable to all conditions a scientific diet cannot be planned unless it is known definitely what people eat.

In one of the Bulletins of the School, Professor Irving Fisher's article "A Graphic Method in Practical Dietetics" was reviewed. The number of the *Journal of the American Medical Association* April 20, 1907, and the reprint of the article, both are exhausted. As his method of calculating food values is very valuable we are republishing in this Supplement the tables given in the original article.

Dr. Fisher's method of calculation is given in the article as follows: "Two methods have hitherto been used for computing proportions of proteids, fats, and carbohydrates. One consists in using the tables of *percentages by weight* of proteids, fats and carbohydrates; the other, Dr. J. H. Kellogg's, in using a table which gives the number of calories in the form of proteids, fats and carbohydrates *per ounce* of each kind of food. These may be described, respectively, as the method, of 'weight per cent' and the method of 'calories per ounce.' The method here suggested is different from either, and may be called the method of 'calories per cent.'

"It takes as its starting point not a unit of weight, but a

unit of *food value,* called a 'standard portion' of each kind of food. A 'standard portion' is defined as that amount of food which contains 100 calories, or food units. A table is constructed which gives the weight in a 'standard portion' of each particular kind of food, and out of the 100 calories contained therein the number of calories in the form of proteids, fats and carbohydrates.

"In order to carry out this method food should be served at the table in 'standard portions,' or simply multiples thereof. The amount of milk served, instead of being a whole number of ounces should be (for average milk) 4.9 ounces — the amount that contains 100 calories. This 'standard portion' constitutes about two-thirds of an ordinary glass of milk. Of the 100 calories which it contains 19 will be in the form of proteid, 52 in fat, and 29 in carbohydrates. In other words, of the food value of milk, 19 per cent is proteid, 52 per cent fat, and 29 per cent carbohydrates.

"One advantage of this method is apparent at once. It enables us to make a true comparison between different foods as to the relative amounts of proteids, fat and carbohydrate. The other methods are misleading in this regard. For instance, though it is well recognized that milk is a higher proteid food than pecan nuts, yet, if we compare milk and the pecans on the basis of the method of weight per cent, we shall find that the pecans appear three times as rich in proteid, milk containing 3.3 per cent and pecans 11 per cent. But if we compare them on the basis of calories per cent we find that, while milk contains 19 calories of proteid out of each 100 of total calories, pecans contain only 6, milk showing three times as much proteid as pecans. * * *

Moreover by having the composition of foods in food

units (calories) the fats are on the same basis as the proteids and carbohydrates. This is not the case in composition by weight, for one ounce of fat in the body produces 264 calories of heat and energy, while one ounce of carbohydrate or proteid produces only 116 calories. Or in grams, one gram fat gives 9.3 calories, one gram carbohydrate or proteid 4.1 calories. (A calorie is approximately the amount of heat required to raise the temperature of 1 pound of water, 4° F.)

THE GRAPHIC METHOD

"Different foods contain the three food elements, proteids, fats and carbohydrates, in different proportions. The tripartite constitution of any particular food is represented in the present method by the position of a point in the triangle CPF (Fig. 1). The method of locating the point on the triangle is analogous to that of locating a city on a map by latitude and longitude; the per cent of proteid in the food is represented, like latitude, by the height of the point above the base line CF (the total height, CP, being taken as 100 per cent). The percentage of fat is represented like longitude, by the distance of the point horizontally from the vertical line CP (the total horizontal breadth, CF, being taken as 100 per cent). Thus, the point O, representing milk, is located at a height above CF ('latitude') 19 per cent of the total height of the triangle, which signifies that 19 per cent of the food value of milk is proteid; and at a distance to the right of CP ('longitude') 52 per cent of the total breadth of the triangle, which signifies that 52 per cent of the food value of milk is fat. Foods high in proteid will be represented by points high up in the triangle. White of egg, of which the food value is all proteid, will be represented at the point P, representing 100 per cent. P is, therefore, called the 'pro-

teid corner' of the triangle. Foods rich in fats, as nuts, cream, and butter, are represented by points far to the right. Pure fats, like olive oil, are located at F at the extreme right, representing 100 per cent of fat. F is therefore called the 'fat corner.'

"The point representing a food is completely located by means of the percentage of proteid and fat; no attention

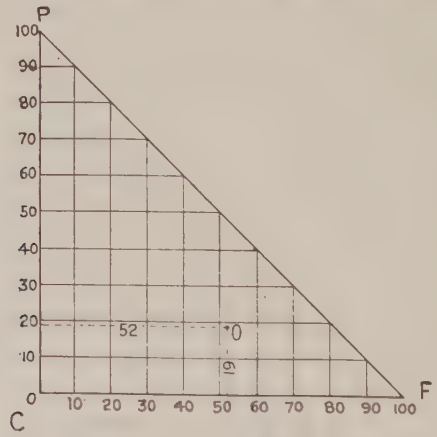
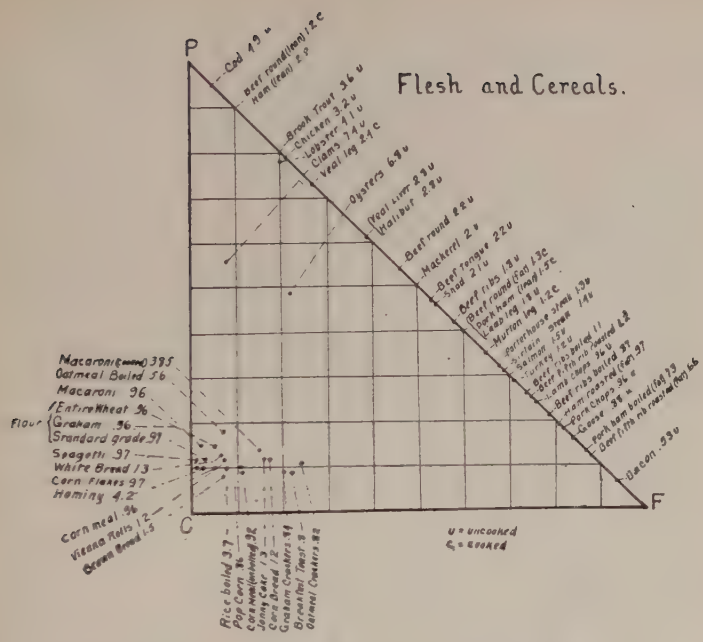
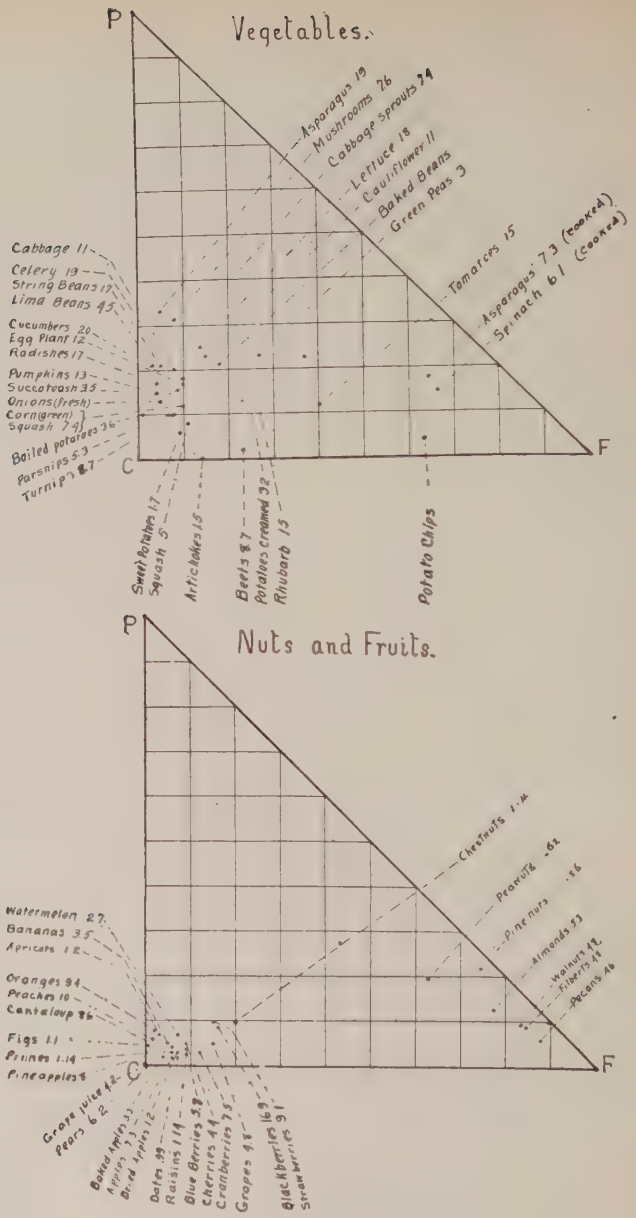


Fig. 1 "Food Map." Composition of Milk Represented by Position of Point O.

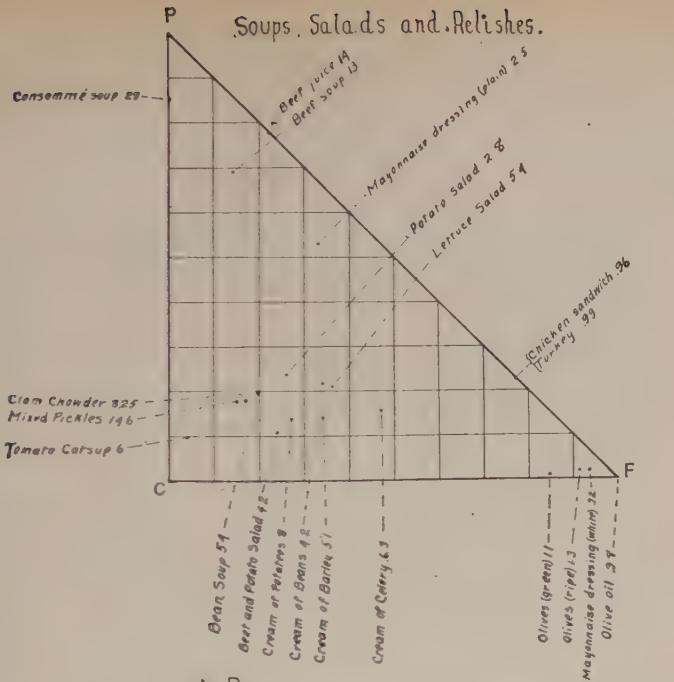
need be paid to the carbohydrate. If one desires a graphic representation of carbohydrates it is found in the distance of the point O from the third side of the triangle, FP (the total distance of this side from the opposite corner being taken as 100 per cent). Foods like bread, cereals and fruits, which are mostly carbohydrate, will thus be represented by points far away from the side FP. Foods such as sugar, of which the food value is wholly carbohydrate, will be repre-

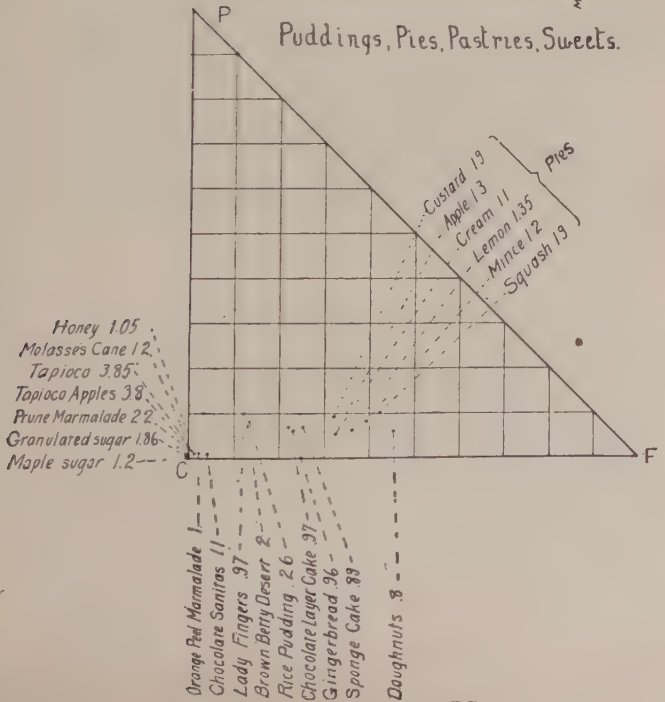


Figs. 2 and 3, "FOOD MAPS"



Figs. 4 and 5, "FOOD MAPS"





Figs. 6 and 7, "FOOD MAPS

sented at the remotest point C, representing 100 per cent carbohydrate, which is, therefore, called the 'carbohydrate corner.'

"Any food is thus represented on the 'food map' by a point, the relative distances of which from the three sides of the triangle represent the proteid, fat and carbohydrate. On this food map, fatty foods are represented by points near the fat corner, F; starchy and saccharine foods by points near the carbohydrate corner, C, and proteid foods by points near the proteid corner, P. A food devoid of proteid is evidently located on the base line C; a food devoid of fat, on the side CP, and a food devoid of carbohydrate on FP. The chief classes are represented in the accompanying diagrams, flesh foods and cereals being shown in Figure 2; dairy products, eggs and meat substitutes in Figure 3; vegetables in Figure 4; nuts and fruits in Figure 5; soups, salads and relishes in Figure 6, and puddings, pies, pastries and sweets in Figure 7. In each case the position of the point relatively to the sides of the triangle represents the proportions of the proteids, fats, and carbohydrates, and the number opposite each name represents the weight (in ounces) of a 'standard portion.' * * *

COMBINATIONS

"The combination of two foods equal in calories is represented by a point midway between them. Thus, to combine one 'portion' of bread and one 'portion' of butter (Fig. 9) draw a straight line between their points and at the middle of it mark a cross and label it '2'; this point will represent two 'portions' of bread and butter.

"If the calories of the two foods are unequal, the point representing the combination will be proportionately nearer

the point with the larger number. Thus, if one portion of bread is combined with one-half portion of butter, the bread and butter point will be midway between the points for bread and for butter, but will lie twice as near the bread point as the butter point.

"When three foods are combined, the point representing the combination is, in like manner, the 'center of gravity' of

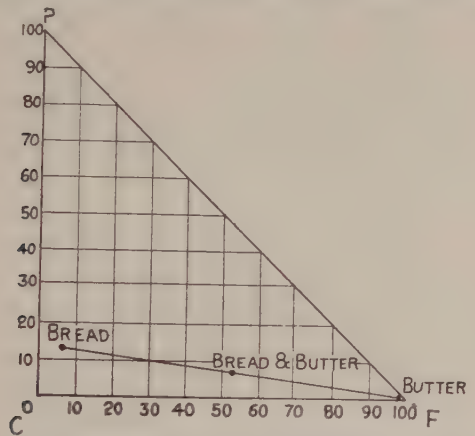


Fig. 9. Food Map Showing Combination of one "Portion" of Bread and one "Portion" of Butter.

the three, and may be found by first obtaining the center of gravity of two, and then obtaining the center of gravity of the point thus obtained, and the third. Thus if, as in Fig. 10, we have three points representing respectively, 3, 4 and 5 calories of three separate foods, shown by the attached numbers 3, 4 and 5, the point representing the combination may be found by joining the points labeled 3 and 4, and finding their center of gravity 7, situated nearer the point 4 than point

3, and dividing the line between them in the ratio of 3 to 4. The first two points, 3 and 4, may be considered as concentrated at 7 with their combined weight, 7. We then find the center of gravity of this new point 7 and the remaining point, 5. The center of gravity at this point 7 and point 5 will be a point 12, on the straight line between them, situated nearer the 7 than the 5, and dividing the distance between in the

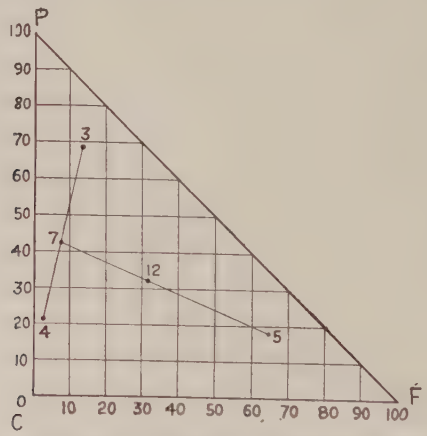


Fig. 10. Showing Method of Combining Three or More Foods.

ratio of 5 to 7. At point 12 the whole combination of 12 portions may be considered to be concentrated. It is evident that we could find the center of gravity of the same three points by combining them in a different order, but the result would be the same.

"It is evident that more than three points may be combined on the same principles by combining them by twos and threes and then combining the combinations. * * * *

"If we accept Professor Chittenden's results as to proteid requirements, a well balanced daily ration for the average person will be represented by a point lying within the 'normal rectangle,' as shown in Fig. 11. This shows that proteid should be near 10 per cent. * * * *

"Since the resultant point, representing the ration, is the center of gravity of the points representing its constituents,

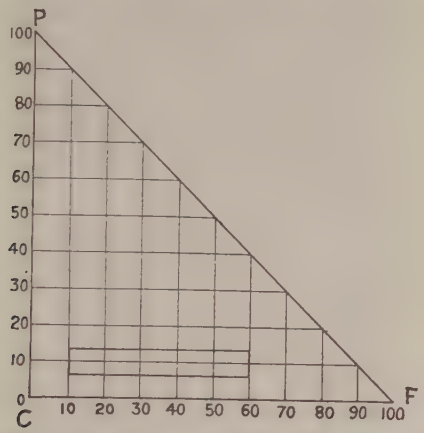


Fig. 11. Food Map with "Normal Rectangle." Chittenden's Standard, of Well Balanced Ration.

it is evident it can be obtained by mechanical as well as by geometrical methods. For this purpose a mechanical diet indicator has been devised, as shown in Fig. 12.

"The essential feature of this apparatus is a card on which is drawn the right-angled triangle with which we have already become familiar. Points on this card may be located to represent the various foods employed. These points may be easily found from table given at the end of this article. . . .

At points representing foods eaten, pins with heavy heads are thrust through the cardboard, the weight of each representing one 'standard portion.' Similar pins but one-half and one-quarter as heavy are also provided to represent half

Fig. 12. Mechanical Diet Indicator.

and quarter 'portions.' When these pins are placed the total ration which has been consumed is easily found, simply by counting the 'portions' thus represented. In order to find the precentages of proteid, fat and carbohydrate in this rations it is only necessary to obtain the center of gravity of all the pins. For this purpose the card is placed in a basket

and suspended on a standard so that the center of gravity is easily indicated on the card by means of a vertical pricker, which may be pressed on the card. Thus, almost instantaneously, the center of gravity is found. The total time consumed in placing the pins, adjusting the card and basket, and finding the center of gravity, is found to be, for accurate work, about five minutes."

Professor Fisher's mechanical diet indicator is now manufactured and may be obtained through the Purchasing Department of this School for $25.00, express collect.

Further details are given in the original article, reprint of which will be *loaned* to *Members of the School* for 1c. postage.

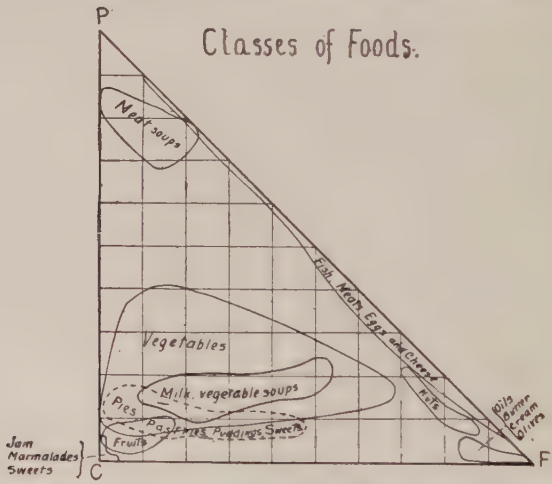
Aside from the "food map" and the diet indicator, the table will repay careful study in making clear the real composition of foods as eaten.

The proportion of proteids given in the table for some of the foods is not absolutely correct, as proteid-like substances like gelatin and also the so-called "extractives," the latter having no food value, are calculated as proteids. The error is not serious, for the proportion of such substances is usually very small.

The table is particularly valuable in showing equivalent total food values. After weighing out a few "portions" of various foods it is very easy to tell by the eye the amount of food being served and so obtain a fairly accurate idea of the total food value of one's diet. An ordinary postal scale will serve for weighing.

An educated appetite is the best guide for diet in health. In a diet for an invalid, foods may easily be served in "standard portions" or multiplies or fractions thereof, so that a physician's prescription as to food may be followed. It would, of course, be necessary to deduct food served but not eaten.

If it is desired to add further items to the table, the weight of a "standard portion" and the calories per cent is found from the percentage composition given in the Department of Agriculture Bulletin No. 28, Chemical Composition of Ameri-



can Food Materials,* as follows: The weight in ounces of a "standard portion" is found by dividing 1,600 by the number of calories per pound given in the table.

The "calories per cent" of proteid is found by multiplying the percentage of proteid in the *Bulletin* table by 1,860 and dividing the result by the figure giving the numbers of calories per pound. The same calculation and the same factor 1,860 applies to carbohydrates. For fat the same calculation applies, but with the substitution of the factor 4,220 in place of 1,860. The three results may be verified by adding the resulting figures for proteid, fat and carbohydrate, the sum of which should be 100 per cent.

* For this Bulletin send 5 cents (*coin*) to the Supt. of Documents, Washington, D. C.

TABLE OF 100 FOOD UNITS

Name of Food	"Portion" Containing 100 Food Units (approx.)	Wt. of 100 Calories		Per cent of		
		Grams	Oz.	Proteid	Fat	Carbohydrate
COOKED MEATS						
†Beef, r'nd, boiled (fat) 1099‡..	Small serving..	36	1.3	40	60	00
†Beef, r'd, boiled (lean) 1206‡	Large serving..	62	2.2	90	10	00
†Beef, r'd, boiled (med.) 1188‡	Small serving..	44	1.6	60	40	00
†Beef, 5th rib, roasted, 1538‡	Half serving...	18.5	.65	12	88	00
†Beef, 5th rib, roasted, 1616‡.	Small serving..	32	1.2	25	75	00
†Beef, 5th rib, roasted, 1615‡.	Very small s'v'g	25	.88	18	82	00
‡Beef, ribs boiled, 1169‡.....	Small serving..	30	1.1	27	73	00
‡Beef, ribs boiled, 1170‡	Very small s'v'g	25	.87	21	79	00
*Calves foot jelly.....	.....	112	4.	19	00	81
*Chicken, canned.....	One thin slice...	27	.96	23	77	00
*Lamb chops, boiled, av.....	One small chop	27	.96	24	76	00
*Lamb, leg, roasted.....	Ord. serving ...	50	1.8	40	60	00
†Mutton, leg, boiled, 1184‡...	Large serving..	34	1.2	35	65	00
†Pork, ham, boiled (fat) 1174‡	Small serving..	20.5	.73	14	86	00
‡Pork, ham, boiled, 1192‡	Ord. serving ...	32.5	1.1	28	72	00
†Pork, ham, r'st'd, (fat) 1484‡	Small serving..	27	.96	19	81	00
†Pork, ham, r'st'd, (lean), 1511‡	Small serving..	34	1.2	33	67	00
*Turkey, as pur., canned.....	Small serving..	28	.99	23	77	00
†Veal, leg, boiled, 1182‡.....	Large serving..	67.5	2.4	73	27	00
UNCOOKED MEATS, EDIBLE PORTION						
*Beef, loin, av. (lean).....	Ord. serving... .	50	1.8	40	60	00
*Beef, loin, av. (fat).....	Small serving..	30	1.1	22	78	00
*Beef, loin, p'house steak, av..	Small steak....	36	1.3	32	68	00
*Beef, loin, sirloin steak, av...	Small steak....	40	1.4	31	69	00
*Beef, ribs, lean, av.....	Ord. serving ...	52	1.8	42	58	00
*Beef, round, lean, av	Ord. serving...	63	2.2	54	46	00
*Beef, tongue, average.....	Ord. serving ...	62	2.2	47	53	00
*Beef, juice.....	.....	395	14.	78	22	00
*Chicken (broilers), av.....	Large serving..	90	3.2	79	21	00
*Clams, r'nd in shell, av.....	Twelve to 16...	210	7.4	56	8	36
*Cod, whole.....	Two servings...	138	4.9	95	5	00
*Goose (young) av.....	Half serving ...	25	.88	16	84	00
*Halibut steaks, av.....	Ord. serving ...	81	2.8	61	39	00
*Liver (veal) av.....	Two small s'v'g	79	2.8	61	39	00
*Lobster, whole, av.....	Two servings...	117	4.1	78	20	2
*Mackerel (Span.), whole, av.	Ord. serving ...	57	2.	50	50	00
*Mutton leg, hind, lean, av....	Ord. serving ...	50	1.8	41	59	00
*Oysters, in shell, av.....	One dozen.....	193	6.8	49	22	29
*Pork, loin chops, av.....	Very small s'v'g	27	.97	18	82	00
*Pork, ham, lean. av.....	Small serving..	36	1.3	29	71	00
*Pork, bacon, med. fat, av....	Small serving..	15	.53	6	94	00
*Salmon (Cal.), average.....	Small serving	42	1.5	30	70	00
Shad. whole, average.....	Ord. serving..	60	2.1	46	54	00
*Trout, brook, whole, av.....	Two small s'v'g	100	3.6	80	20	00
*Turkey. average.....	Two small s'v'g	33	1.2	29	71	00

Name of Food	"Portion" Containing 100 Food Units (approx.)	Wt. of 100 Calories		Per cent of		
		Grams	Oz.	Proteid	Fat	Carbohydrate
VEGETABLES						
*Artichokes, av. canned		430	15	14	0	86
*Asparagus, av. canned		540	19	33	5	62
*Asparagus, av. cooked		206	7.19	18	63	19
*Beans, baked, canned	Small side dish.	75	2.66	21	18	61
*Beans, Lima, canned	Large side dish.	126	4.44	21	4	75
*Beans, string, cooked	Five servings	480	16.66	15	48	37
*Beets edible portion, cooked	Three servings	245	8.7	2	23	75
*Cabbage, edible portion		310	11	20	8	72
*Carrots, edible pt., fresh		215	7.6	10	8	82
Carrots, cooked	Two servings.	164	5.81	10	34	56
*Cauliflower, as purchased		312	11	23	15	62
*Celery, edible portion		540	19	24	5	71
Corn, sweet, cooked	One side dish	99	3.5	13	10	77
*Cucumbers, edible pt		565	20	18	10	72
*Egg plant, edible pt		350	12	17	10	73
Lentils, cooked		89	3.15	27	1	72
*Lettuce, edible pt		505	18	25	14	61
*Mushrooms, as purchased		215	7.6	31	8	61
*Onions, fresh, edible pt		200	7.1	13	5	82
*Onions, cooked	Two large s'v'gs	240	8.4	12	40	48
*Parsnips, edible pt	1½ serving	152	5.3	10	7	83
Parsnips, cooked		163	5.84	10	34	56
*Peas, green, canned	Two servings	178	6.3	25	3	72
*Peas, green, cooked	One serving	85	3	23	27	50
Potatoes, baked	One good sized.	86	3.05	11	1	88
*Potatoes, boiled	One large sized.	102	3.62	11	1	88
*Potatoes, mashed (creamed)	One serving	89	3.14	10	25	65
Potatoes, steamed	One serving	101	3.57	11	1	88
*Potatoes, chips	One-half s'v'g	17	.6	4	63	33
*Potatoes, sweet, cooked	Half av potato.	49	1.7	6	9	85
*Pumkpins, edible pt		380	13	15	4	81
Radishes, as purchased		480	17	18	3	79
Rhubarb, edible, pt		430	15	10	27	63
*Spinach, cooked	Two ord. s'v'g.	174	6 1	15	66	19
Squash, edible pt		210	7.4	12	10	78
*Succotash, canned	Ord. serving	100	3.5	15	9	67
*Tomatoes, fresh as purchased	Four av	430	15	15	16	69
Tomatoes, canned		431	15.2	21	7	72
*Turnips, edible pt	Two large s'v'g	246	8.7	13	4	83
Vegetable oysters		273	9.62	10	51	39
FRUITS (DRIED)						
*Apples, as purchased		34	1.2	3	7	90
Apricots, as purchased		35	1.24	7	3	90
*Dates, edible portion	Three large	28	.99	2	7	91
*Dates, as purchased		31	1.1	2	7	91
*Figs, edible portion	One large	31	1.1	5	0	95
*Prunes, edible portion	Three large	32	1.14	3	0	97
*Prunes, as purchased		38	1.35	3	0	97
*Raisins, edible portion		28	1.	3	9	88
*Raisins, as purchased		31	1.1	3	9	88

Name of Food	"Portion" Containing 100 Food Units (approx.)	Wt. of 100 Calories		Per cent of		
		Grams	Oz.	Proteid	Fat	Carbohydrate
FRUITS (FRESH OR COOKED)						
*Apples, as purchased	Two apples	206	7.3	3	7	90
Apples, baked		94	3.3	2	5	93
Apples, sauce	Ord. serving	111	3.9	2	5	93
*Apricots, edible pt		168	5.92	8	0	92
Apricots, cooked	Large serving	131	4.61	6	0	94
*Bananas, edible pt	One large	100	3.5	5	5	90
*Blackberries		170	5.9	9	16	75
Blueberries		128	4.6	3	8	89
*Blueberries, canned		165	5.8	4	9	87
Cantaloupe	Half or. serv'g	243	8.6	6	0	94
*Cherries, edible portion		124	4.4	5	10	85
*Cranberries, as purchased		210	7.5	3	12	85
*Grapes, as purchased av		136	4.8	5	15	80
Grape fruit		215	7.57	7	4	89
Grape juice	Small glass	120	4.2	0	0	100
Gooseberrries		261	9.2	5	0	95
Lemons		215	7.57	9	14	77
*Lemon juice		246	8.77	0	0	100
Nectarines		147	5.18	4	0	96
Olives, ripe	About seven	37	1.31	2	91	7
Oranges, as purchased, av	One very large	270	9.4	6	3	91
*Oranges, juice	Large glass	188	6.62	0	0	100
Peaches, as purchased av	Three ordinary	290	10.	7	2	91
*Peaches, sauce	Ord. serving	136	4.78	4	2	94
Peaches, juice	Ordinary glass	136	4.80	0	0	100
Pears	One large pear	173	5.40	4	7	89
*Pears, sauce		113	3.98	3	4	93
Pineapples, edible p't'n, av		226	8.	4	6	90
*Raspberries, black		146	5.18	10	14	76
Raspberries, red		178	6.29	8	0	92
Strawberries, av	Two servings	260	9.1	10	15	75
*Watermelon, av		760	27.	6	6	88
*						
DAIRY PRODUCTS						
*Butter	Ordinary pat	12.5	.44	.5	99.5	00
*Buttermilk	1 ½ glass	275	9.7	34	12	54
*Cheese, Am., pale	1 ½ cubic in	22	.77	25	73	2
*Cheese, cottage	4 cubic in	89	3.12	76	8	16
*Cheese, full cream	1 ½ cubic in	23	.82	25	73	2
*Cheese, Neufchatel	1 ½ cubic in	29.5	1.05	22	76	2
*Cheese, Swiss	1 ½ cubic in	23	.8	25	74	1
*Cheese, pineapple	1 ½ cubic in	20	.72	25	73	2
*Cream	¼ ord. glass	49	1.7	5	86	9
Kumyss		188	6.7	21	37	42
*Milk, condensed, sweetened		30	1.06	10	23	67
*Milk, condensed, unsweet'd		59	2.05	24	50	26
*Milk, skimmed	1 ½ glass	255	9.4	37	7	56
*Milk, whole	Small glass	140	4.9	19	52	29
Milk, human, 2nd week		162	5.7	11	47	42
Milk, human, 3rd month		171	6	7	46	47
*Whey	Two glasses	360	13	15	10	75

Name of Food	"Portion" Containing 100 Food Units (approx.)	Wt. of 100 Calories		Per cent of		
		Grams	Oz.	Proteid	Fat	Carbohydrate
CAKES, PASTRY, PUDDINGS AND DESSERTS						
*Cake, chocolate layer	Half ord. sq. pc	28	.98	7	22	71
*Cake, gingerbread	Half ord. sq. pc	27	.96	6	23	71
Cake, sponge	Small piece	25	.89	7	25	68
Custard, caramel		71	2.51	19	10	71
Custard, milk	Ordinary cup	122	4.29	26	56	18
Custard, tapioca	Two-thirds ord.	69.5	2.45	9	12	79
*Doughnuts	Half a doughn't	23	.8	6	45	49
*Lady fingers	Two	27	.95	10	12	78
*Macaroons	Four	23	.82	6	33	61
*Pie, apple	One third piece	38	1.3	5	32	63
*Pie, cream	One-fourth pc.	30	1.1	5	32	63
*Pie, custard	One-third piece	55	1.9	9	32	59
*Pie, lemon	One-third piece	38	1.35	6	36	58
*Pie, mince	One-fourth pc.	35	1.2	8	38	54
*Pie, squash	One-third piece	55	1.9	10	42	48
Pudding, apple sago		81	3.02	6	3	91
Pudding, brown betty	Half ord. s'v'g	56.6	2.	7	12	81
Pudding, cream rice	Very small s'v'g	75	2.65	8	13	79
Pudding, Indian meal	Half ord. ser'g.	56.6	2.	12	25	63
Pudding, apple tapioca	Small serving	79	2.8	1	1	98
Tapioca, cooked	Ord. serving	108	3.85	1	1	98
SWEETS AND PICKLES						
*Catsup, tomato, av		170	6.	10	3	87
Candy, plain		26	.9	0	0	100
Candy, chocolate		30	1.1	1	4	95
*Honey	Four teasp'ns.	30	1.05	1	0	99
*Marmalade (orange)		28.3	1	.5	2.5	97
*Molasses, cane		35	1.2	.5	0	99.5
*Olives, green edible portion	Five to seven	32	1.1	1	84	15
*Olives, ripe, edible portion	Five to seven	38	1.3	2	91	7
*Pickles, mixed		415	14.6	18	15	67
*Sugar, granulated	Three heaping tsp or 1 ½ lumps.	24	.86	0	0	100
*Sugar, maple	Four teaspoons	29	1.03	0	0	100
*Syrup, maple	Four teaspoons	35	1.2	0	0	100
NUTS, EDIBLE PORTION						
*Almonds, av	Eight to 15	15	.53	13	77	10
*Beechnuts		14.8	.52	13	79	8
*Brazil Nuts	Three ord. size.	14	.49	10	86	4
*Butternuts		14	.50	16	82	2
*Cocoanuts		16	.57	4	77	19
*Chestnuts, fresh, av		40	1.4	10	20	70
*Filberts, av	Ten nuts	14	.48	9	84	7
*Hickory nuts		13	.47	9	85	6
*Peanuts, av	Thirteen double	18	.62	20	63	17
*Pecans, polished	About eight	13	.46	6	87	7
*Pine nuts, (pignolias)	About eighty	16	56	22	74	4
*Walnuts, California	About six	14	.48	10	83	7

Name of Food	"Portion" Containing 100 Food Units (approx.)	Wt. of 100 Calories		Per cent of		
		Grams	Oz.	Proteid	Fat	Carbohydrate
CEREALS						
*Bread, brown, average	Ord. thick slice.	43	1.5	9	7	84
*Bread, corn (johnnycake) av.	Small square.	38	1.3	12	16	72
*Bread, white, home made	Ord. thick slice	38	1.3	13	6	81
*Cookies, sugar	Two	24	.83	7	22	71
Corn flakes, toasted	Ord. cer. dish f'l	27	.97	11	1	88
*Corn meal, granular, av.	2½ level tbsp.	27	.96	10	5	85
Corn meal, unbolted, av.	Three tbsp.	26	.92	9.	11.	80
*Crackers, graham	Two crackers.	23	.82	9.5	20 5	70
*Crackers, oatmeal	Two crackers.	23	.81	11	24	65
*Crackers, soda	3½ "Uneedas"	24	.83	9.4	20	70.6
*Hominy, cooked	Large serving.	120	4.2	11	2	87
*Macaroni, av.		27	.96	15	2	83
*Macaroni, cooked	Ord. serving.	110	3.85	14	15	71
*Oatmeal, boiled	1½ serving.	159	5.6	18	7	75
*Popcorn		24	.86	11	11	78
*Rice, uncooked		28	.98	9	1	90
*Rice, boiled	Ord. cereal dish	87	3.1	10	1	89
*Rice, flakes	Ord. cereal dish.	27	.94	8	1	91
*Rolls, Vienna, av.	One large roll.	35	1.2	12	7	81
*Shredded wheat	One biscuit.	27	.94	13	4.5	82.5
*Spaghetti, average		28	.97	12	1	87
*Wafers, vanilla	Four	24	.84	8	13	71
*Wheat, flour, e't'e w'h't, av.	Four tbsp	27	.96	15	5	80
*Wheat, flour, graham, av.	4½ tbsp	27	.96	15	5	80
*Wheat, flour, patent, family and straight grade spring wheat, av.	Four tbsp.	27	.97	12	3	85
*Zweiback	Size of thick slice of bread	23	.81	9	21	70
MISCELLANEOUS						
*Eggs, hen's boiled	One large egg.	59	2.1	32	68	00
*Eggs, hen's whites	Of six eggs	181	6.4	100	0	00
*Eggs, hen's yolks	Two yolks	27	.94	17	83	00
*Omelet		94	3.3	34	60	6
*Soup, beef, av.		380	13.	69	14	17
*Soup, bean, av.	Very large plate	150	5.4	20	20	60
*Soup, cream of celery	Two plates	180	6.3	16	47	37
*Consomme		830	29.	85	00	15
*Clam chowder	Two plates	230	8.25	17	18	65
†Chocolate, bitter	Half-a-square.	16	.56	8	72	20
*Cocoa		20	.69	17	53	30
Ice Cream (Phila)	Half serving	45	1.6	5	57	38
Ice Cream (New York)	Half serving	48	1.7	7	47	46

*Chemical Composition of American Food Materials, Atwater and Bryant, U. S. Department of Agriculture Bull. No. 28.

†Experiments on Losses in Cooking Meats. (1900–03), Grindley, U. S. Department of Agriculture Bull. No. 141.

‡Laboratory number of specimen, as per Experiments on Losses in Cooking Meat.

FOOD VALUES IN CALORIES PER OUNCE

In some respects Dr. Kellogg's method of giving the composition of foods in food units (calories) per ounce is simpler and more useful in the actual calculation of dietaries. By having a table with composition in food units, the day's ration may be calculated by simple addition, combined with a little mental multiplication. If the results are wanted in ounces, the calories of proteid or carbohydrate are divided by 116, and calories of fat by 264. For grams, the factor is 4.1 for proteids and carbohydrate and 9.3 for fats.

Such a table is given in the Battle Creek Sanitarium *Diet List* which contains the composition of all foods served at that institution in calories per ounce. Dr. Fisher's method of serving the food in "standard portions" has been adopted and the figures by that method of calculation are also given in the last edition of the booklet.

The *Diet List* also contains tables giving normal height, weight, skin surface and calories required, on the average, for men and women, boys and girls, per day. Some of these tables are given in the following pages, also the calculation of a dietary with the figures in calories per ounce and one with food served in 100 calorie portions.

These tables are based on Professor Chittenden's standards and so are lower in proteid requirements and total food value than the Atwater standard dietaries. For example, the diet for an average man, 5 feet 8 inches tall and weighing 157 pounds, is given as 236 calories of proteid, 708 calories of fat, 1,416 calories of carbohydrates, with a total of 2,360 calories per day.

The Atwater standard for man with light exercise is 100 grams of proteid, 100 grams of fat, 360 grams of carbohydrate, or on a calorie basis: 410 calories of proteid, 930 calories of fat, 1,476 calories of carbohydrate, total 2,816 calories or nearly 20 per cent higher in total food value.

Under the Chittenden standard, of every 100 food units about 10 should be proteid, 30 fat and 60 carbohydrate. Based on the Atwater standard, of 100 food units, about 14 are proteid, 32 fat, and 52 carbohydrate.

It must be remembered that no one in formulating a "standard diet" attempts to give anything more than a possible average, from which to vary, according to conditions. It is recognized that health may be maintained on various proportions of proteid and that the ratio of fat to carbohydrates is immaterial, provided digestion remains perfect.

The following table has been taken from some of the figures in the *Diet List*. The figures based on standard portions are omitted.

NOTE — Members of the School are expected hereafter to solve question No. 21, Part I, *Food and Dietetics* — "Calculate the amount of proteid, carbondrate and fat in your own diet for one day," in the usual way, as shown on page 193, and by the "calories per ounce" method, using the following figures. The total calories should be found by each method. The two figures will not come out exactly the same, but should be approximate.

Also plot one of these meals on the enlarged "Food Map" on page 223. Find the "center of gravity" by the method shown in Figs. 9 and 10. This is most easily done by marking and folding a strip of paper to find halves, thirds, etc. Say what the resulting point represents in terms of calories and of ounces of proteids, fats and carbohydrates. Give full details.

These "Food Maps" may be obtained of the School in quantity, printed on good paper—25 for 10 cents, 100 for 30 cents (in stamps).

FOOD VALUES IN FOOD UNITS PER OUNCE

	Calories Per Ounce			
	Proteid	Fat	Carbohydrate	Total
Apples, baked	.6	1.3	28.4	30.3
Apples, fresh	2.75	7.15	91.3	101.1
Apple sauce	.3	.8	20.6	21.7
Apricots	1.3	0	15.6	16.9
Asparagus in cream	2.8	17	4.9	24.7
Bananas	1.5	1.6	25.7	28.8
Barley, pearl	2.97	.87	27.24	31.08
Beans, string, (cooked)	.9	2.9	2.2	6
Beets, (cooked)	2.7	.3	8.6	11.6
Biscuit, cream	10.3	27.5	49.6	87.5
Blanc Mange, Farina	4.16	21.56	18.6	44.4
Bread, corn	8.5	12.3	52	72.8
Bread, graham	10.4	4.8	60.8	76
Bread, rye	10.5	1.6	62.1	74.2
Bread, white	9.3	3.7	63.4	76.4
Bread, whole wheat	11.3	2.4	58	71.7
Buns	7.3	17.3	66.8	91.4
Butter, (dairy)	1.2	226.6	0	227.8
Buttermilk	3.5	1.3	5.6	10.4
Cake, frosted	6.8	24	74.9	105.7
Cake, layer	8.2	45.1	76.5	130.6
Cake, sponge	12.4	14.2	94.2	120.8
Candy, (Sanitas chocolates)	1	3.8	85.2	90
Canteloupe	.7		10.9	11.6
Carrots, creamed	2.01	7.5	10.3	19.8
Cashew nuts	28.87	125.7	28.24	182.81
Celery	1.3	.3	3.9	5.5
Cheese, cottage	19.9	12.4	5.1	37.3
Crackers, graham	11.7	25.1	86.1	122.9
Crackers, oatmeal	13.3	29.6	80.5	123.8
Cream	2.9	49.3	5.3	57.5
Cream sauce	3.7	22.9	9	35.6
Custard, caramel	5.2	11.4	23.6	40.2
Custard, plain	5.7	13	12.5	31.2
Dates	2.5	7.5	91.5	101.5
Eggs, poached, etc	16.3	32		48.3
Eggs (each, whole, a'v'g.)	26.3	41.9		68.2
Eggs (white) each	15.5	.6		16.1
Eggs (yolk) each	10.8	41.3		52.1
Figs	.5	8	86.6	92.4
Grape fruit	.9	.5	11.8	13.2
Grapes	1.16	3.2	16.6	20.9
Gruel, barley	1.48	.7	10.2	12.39
Gruel, oatmeal	1.3	1.4	5.8	8.5
Honey	.5		94.7	95.2
Macaroni and tomato	5	3.86	17.16	26
Maple syrup			83	83
Mayonnaise, cooked	6.87	87.1	2.85	76.8

	Calories Per Ounce			
	Proteid	Fat	Carbohydrate	Total
Milk, skimmed	4	.8	6	10.8
Milk, whole	3.8	11	5.8	20.6
Nut butter	34.2	124	20	178.2
Nuts, almonds	24.5	146.4	20.2	191.1
Nuts, Brazil	19.8	178.1	8.2	206.1
Nuts, Filberts	18.2	174.1	15.2	207.5
Nuts, Pecans	11.2	188	17.8	217.8
Nuts, walnut, Eng.	19.4	169.2	18.2	206.8
Oats, rolled (cooked)	3.3	1.3	13.4	18
Olive oil	0	264.1	0	264.1
Olives, ripe (7)	2	69.1	5	76.1
Onions, boiled	1.13	4.29	5.1	10.52
Oranges	.9	.5	13.5	14.9
Parsnips, creamed	2.56	6.5	17.29	26.35
Peanuts	30.1	102.9	8.5	161.5
Pears	.7	1.3	16.5	18.5
Peas, green	7.8	9.1	17.5	34.4
Pie, apple	7.5	18	37.2	62.7
Pie, custard	4.9	16.8	30.5	52.2
Pie, squash	4.27	22.7	36.5	63.5
Potatoes, baked	3.4	.4	28.9	32.7
Potatoes, boiled	2.9	.3	24.4	27.6
Potatoes, mashed	3	8	20.8	31.8
Potatoes, sweet, browned	4.11	11.25	59.7	75
Prunes (cooked)	.8	.3	26.4	27.5
Pudding, baked Indian	4.8	21.8	20	46.6
Pudding, bread custard	6.44	32	19.12	37.56
Pudding, snow	4.78	9.22	16.37	30.38
Pudding, apple tapioca	4.5	17.58	26.44	48.5
Raisins	3	8.8	88.8	100.6
Rice, boiled	3.3	.3	28.5	32.1
Salad, apple and celery	2.26	4.27	26.16	32.7
Salad, egg mayonnaise	13.37	30.66	1.46	44.5
Salad, potato	4.56	25.77	15.06	45.39
Sandwich, cottage cheese	11.2	33.9	37.6	82.8
Soup, cream of celery	2.8	19	4.7	26.5
Soup, cream of potato	2.7	19.2	.9	30.9
Soup, split pea	7.18	1.85	18.07	27.1
Soup, tomato bisque	3.1	10.5	2.4	16
Soup, vegetable	.96	5.71	6.9	13.5
Spinach	3.3	1	4.93	9.3
Squash, steamed or canned	1	1.3	12.3	14.6
Sugar (granulated)	0	0	116.6	116.6
Toast, breakfast	11.4	27.5	86.2	125.15
Toast, cream	4.15	29.9	13.6	47.6
Tomatoes, stewed or canned	1.4	.5	4.7	6.6
Wheat flakes, toasted	11	3.9	88.9	103.8
Zwieback	11.4	26.4	85.8	123.6

	Calories Per Ounce			
	Proteid	Fat	Carbohydrate	Total
FLESH FOODS				
Beef, roasted (fat)	18.14	136.85	0	155.26
Beef, round (boiled, lean)	40.9	4.54	0	45.6
Bouillon	2.3	.3	3	3
Chicken (broilers)	24.6	6.56	0	31.16
Cod fish	19.3	1.02	0	20.32
Goose	18.1	95.4	0	113.5
Halibut (steak)	21.78	13.9	0	35.68
Lamb chops (boiled)	25.3	79.7	0	105
Lamb (leg, roast)	22.2	33.3	0	55.5
Liver (veal)	21.78	13.9	0	35.68
Lobsters	19	4.8	0	23.82
Mutton (leg, boiled)	29.1	54.1	0	83.2
Oysters	7.2	3.23	0	10.43
Pork (bacon, smoked medium fat)	11.3	177.3	0	188.6
Pork (ham, boiled)	25.4	65.4	0	90.3
Pork (loin, chops)	18.5	84.5	0	103
Salmon (California)	20.4	46.6	0	66.6
Shad	21.9	25.71	0	47.61
Trout (brook)	22.2	55.5	0	77.7
Turkey	24.1	59.1	0	83.2
Veal (leg, boiled)	30.4	11.2	0	41.6
UNCOOKED FOODSTUFFS.				
Barley, pearled	9.9	2.9	90.8	103.6
Beans (dried)	26.3	4.8	69.5	100.6
Cocoa	25.2	77.1	44.0	146.3
Corn, green	3.6	2.9	23.0	29.5
Cornmeal	10.7	5.1	87.9	103.7
Cornstarch			105.0	105.0
Flour, graham	15.5	5.9	83.3	104.7
Flour, rye	7.9	2.4	91.8	102.1
Flour, wheat (entire wheat)	16.1	5.1	83.8	105.0
Flour, wheat (patent)	12.6	2.9	87.7	103.2
Lemon juice	0	0	11.4	11.4
Macaroni	3.5	4.0	18.4	25.9
Oatmeal	18.8	19.2	78.8	116.8
Oats, rolled	19.5	19.5	77.2	116.2
Peas (dried)	28.7	2.7	72.3	100.7
Peas, green	8.2	1.3	19.7	29.2
Potatoes	2.6	.3	21.5	24.4
Rice	9.0	.8	92.0	101.8
Sweet potatoes	2.1	1.9	32.0	36.0
Wheat, cracked	13.0	4.3	88.1	106.6

Tables Showing Average Height, Weight, Skin Surface and Food Units Required Daily With Very Light Exercise

BOYS

Age	Height in Inches	Weight in Pounds	Surface in Square Feet	Calories or Food Units
5	41.57	41.09	7.9	816.2
6	43.75	45.17	8.3	855.9
7	45.74	49.07	8.8	912.4
8	47.76	53.92	9.4	981.1
9	49.69	59.23	9.9	1,043.7
10	51.58	65.30	10.5	1,117.5
11	53.33	70.18	11.0	1,178.2
12	55.11	76.92	11.6	1,254.8
13	57.21	84.85	12.4	1,352.6
14	59.88	94.91	13.4	1,471.3

GIRLS

Age	Height in Inches	Weight in Pounds	Surface in Square Feet	Calories or Food Units
5	41.29	39.66	7.7	784.5
6	43.35	43.28	8.1	831.9
7	45.52	47.46	8.5	881.7
8	47.58	52.04	9.2	957.1
9	49.37	57.07	9.7	1,018.5
10	51.34	62.35	10.2	1.081.0
11	53.42	68.84	10.7	1.148.5
12	55.88	78.31	11.8	1,276.8

MEN

Height in In.	Weight in Pounds	Surface in Square Ft.	Calories or Food Units			
			Proteids	Fats	Carbohydrates	Total
61	131	15.92	197	591	1,182	1,970
62	133	16.06	200	600	1,200	2,000
63	136	16.27	204	612	1,224	2,040
64	140	16.55	210	630	1,260	2,100
65	143	16.76	215	645	1,290	2,150
66	147	17.06	221	663	1 326	2,210
67	152	17 40	228	684	1,368	2,280
68	157	17.76	236	708	1,416	2,360
69	162	18.12	243	729	1.458	2,430
70	167	18.48	251	753	1.506	2.510
71	173	18.91	260	780	1.560	2,600
72	179	19.34	269	807	1,614	2,690
73	185	19.89	278	834	1.668	2,780
74	192	20.33	288	864	1,728	2,880
75	200	20.88	300	900	1,800	3.000

WOMEN

Height in In.	Weight in Pounds	Surface in Square Ft.	Calories or Food Units			
			Proteids	Fats	Carbohydrates	Total
59	119	14.82	179	537	1,074	1,790
60	122	15.03	183	549	1,098	1,830
61	124	15 29	186	558	1,116	1,860
62	127	15 50	191	573	1,146	1,910
63	131	15.92	197	591	1.182	1.970
64	134	16.13	201	603	1,206	2.010
65	139	16.48	209	627	1.254	2,090
66	143	16.76	215	645	1.290	2.150
67	147	17.06	221	663	1,326	2,210
68	151	17.34	227	681	1,362	2,270
69	155	17.64	232	696	1,392	2.320
70	159	17.92	239	717	1,434	2,390

NOTE—With active exercise an increase of about 20 per cent total food units may be needed.

Dietary Calculation with Food Values in Calories per Ounce

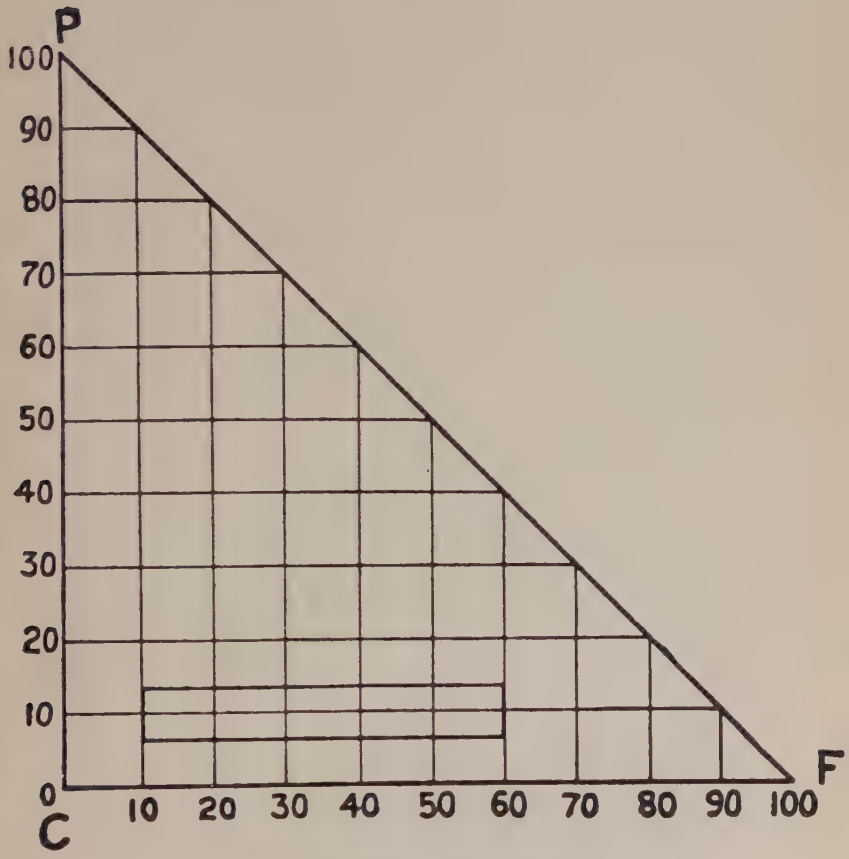
Breakfast	Proteids	Fats	Carbohydrates	Total
	4.7	*.2*	*6.0*	
Gluten Gruel 5 oz.	23.5	1.0	30.0	
(each)	*26.3*	*41.9*		
Soft-Boiled Egg	26.3	41.9		
			86.2	
Malt Honey 1 oz.			86.2	
	3.0	*8.0*	*20.8*	
Creamed Potatoes 5 oz.	15.0	40.0	104.0	
	11.4	*26.4*	*85.8*	
Zwieback 2 oz.	22.8	52.8	171.6	
	11.2	*188.0*	*17.8*	
Pecans ¾ oz.	8.4	141.0	13.4	
	.5	*1.3*	*16.6*	
Apple 5 oz.	2.5	6.5	83 0	
	98.5	283.2	488.2	869.9

Dietary Calculation with Food Served in 100 Calories Portions

Dinner	Portions in serving	Proteins	Fats	Carbo-hydrates	Total
French Soup	½	10	20	20	
Nut Sauce	1	29	55	16	
Macaroni, Egg	1	15	59	26	
Baked Potato	2	22	2	176	
Cream Gravy	½	5	33	12	
Biscuit	1½	20	2	128	
Butter	1	1	99		
Honey	2			200	
Celery	¼	4		21	
Apple Juice	½			50	
	10¼	106	270	649	1,025

Hourly Outgo in Heat and Energy from the Human Body as Determined in the Respiration Calorimeter by the U. S. Dept. of Agriculture

Average (154 lbs.)	Calories
Man at rest (asleep)	65
Sitting up (awake)	100
Light exercise	170
Moderate exercise	190
Severe exercise	450
Very severe exercise	600



DR. FISHER'S FOOD MAP

Normal Rectangle for a Balanced Diet, Chittenden's Standard

PROTEIN METABOLISM IN ITS RELATION TO DIETARY STANDARDS*

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Present views concerning the role of fats, carbohydrates, and proteins in the animal organism are not essentially different from views that prevailed a generation ago. An earlier theory, brilliant but untenable in the light of later more exact experiments, was advanced by Liebig about the middle of the 19th century. This theory held that the protein taken with the food constitutes the sole source of muscular energy and that fats and carbohydrates serve only to maintain the body temperature.

LIEBIG'S THEORY

Voit, in the course of experiments undertaken to test the validity of Liebig's theory, established the remarkable fact that severe physical work is not accompanied by any material increase in the destruction of protein within the animal organism, as of course would be the case if protein were the sole or even the chief source of muscular energy. The destruction of Liebig's erroneous but definite theory of metabolism naturally led to renewed investigations concerning the function of fats, carbohydrates, and

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protein; and in this necessary constructive work, Voit became the recognized leader. From his laboratory came investigations and deductions which have since been almost universally accepted as final.

Voit's dietary standards, the practical outcome of all this work, are intended to represent a few fundamental facts. A man of average size gives off in a day a certain quantity of energy (in the form of work and heat). This energy can be measured and often has been measured, with a fair degree of accuracy. The more physical work a man does the more energy both in the form of work and of heat is given off, and the increase in energy consumption due to work or exercise has also been measured. The daily consumption of energy in the animal organism is obtained at the expense of food. And since it is known just how much energy can be obtained from burning a given quantity of fat, starch, or protein, it becomes theoretically simple, and practically quite possible, to calculate the amount of food that a given individual doing a certain work must consume in order to maintain the equilibrium of the intake and outgo of energy. Such calculations are based on the assumption that food materials when oxidized within the animal organism liberate the same amount of energy as when burned in ordinary air or oxygen, and there is no reason to doubt the correctness of this assumption.

VOIT'S DIETARY STANDARDS

In so far as Voit's dietary standards prescribe the amount of dry food material, of available energy-giving material necessary under given conditions, they have undoubtedly been of very great service. The dietary standards, however, prescribe not only how much available energy the daily food must contain, but also how much of that energy can be most profitably supplied in the form of protein and how much in the form of fats and carbohydrates. Voit's well known average diet, for example, calls for 56 gm. fat, 500 gm. carbohydrates, and 118 gm. protein.

The justification and probable value of such more specific standards of diet is the subject of this paper, and it is a subject on which I think there is room for differences of opinion. It should, however, at once be stated that such differences of opinion do not concern the non-nitrogenous part of the dietary standards. Voit, and with him all competent to have an opinion, are agreed that the fats and carbohydrates need not at all be provided in the ratio of 56 to 500.

PROPORTION OF FATS TO CARBOHYDRATES

It is a well-known fact that if more fat than the animal organism can advantageously oxidize is supplied, such fat, in so far as it is absorbed, is stored as fat in the body. If an excess of carbohydrates is taken, such excess is also converted into fat and is

likewise stored as fat for future use. Further Pflüger has recently advanced the not improbable hypothesis that fats are not completely oxidized as such within the animal organism, but are first converted into carbohydrates. The animal organism is then able to convert carbohydrates into fat and fat into carbohydrates according to its needs, and the logical conclusion therefore is quite in harmony with the accepted view that it is theoretically a matter of relatively small importance what ratio is selected for the fats and carbohydrates. The two taken together must of necessity furnish the greater part of the fuel value of the food, but upon individual peculiarities, relative cost, and a number of other accidental factors depends what ratio between the two may be most suitable in any given case.

PROTEIN IN THE DIETARY

With regard to the protein prescribed by the dietary standards the case is different. The animal or human organism, while able to convert carbohydrates into fat and probably also fat into carbohydrates, can effect no such transformation of non-nitrogenous food into the highly nitrogenous proteins. It may be able to produce carbohydrates, and therefore also fat, out of protein, but it certainly can not produce protein out of fat or carbohydrates. The protein of the food not only furnishes energy and heat, as do the fats and carbohydrates, but it, and it alone,

furnishes the material which replaces the constant loss of living protoplasm. It is therefore clearly necessary that the daily food should contain enough protein to protect the organism against loss of body tissue. On the other hand, it is generally believed that instead of being advantageous it is probably detrimental to the full-grown organism to have to take care of more protein than is needed for the replacement of lost tissue material. An excess of fat or carbohydrates, the human organism can to a very great extent take care of by adding it to its store of body fat, but it has not the power similarly to increase its supply of reserve protein. Any excess of nitrogenous material supplied with the food leads at once to a correspondingly increased destruction of protein. And the formation of excessive quantities of nitrogenous katabolism products within the body is supposed to be more or less a source of danger. I think all are agreed that gout at least is largely the result of "high living."

MINIMUM PROTEIN

The important question then is, How much protein must the diet of normal persons contain? Voit came to the difinite conclusion that 118 grams are needed for a man weighing 70 kilos (150 lbs.), and for more than a generation this figure has been generally accepted as substantially correct. But is it? Since the publication in 1881 of Voit's great mono-

graph on metabolism it has been shown by Hirschfeld, Klemperer, Pechsel, and Sivèn that the daily protein destruction in men of average size can be reduced to 40 grams or less, and that nitrogen equilibrium can be maintained by furnishing such small amounts of protein with the food. The experiments by means of which Voit secured the almost universal acceptance of his standard minimum protein requirement are essentially similar and in no way superior to these more modern experiments which seem to prove that 40 grams of protein, or less, are enough to maintain nitrogen equilibrium. One might therefore suppose that the later experiments would have been accepted as proving the erroneousness of Voit's figures, or that they would at least have been deemed sufficiently important to lead to a general reopening of the whole question. But the earlier conclusions and generalizations of Voit had in the meantime, so to speak, survived the probation period, and had become the accepted doctrine, not to say tradition, of the scientific public. In addition, it must be remembered that Voit's standard comes much nearer the average common usage. The widespread and earnest acceptance of Voit's figure is undoubtedly in a great measure due to the fact that it agrees tolerably well with the protein consumption actually prevailing among the people, specially among those not too poor to procure the more expensive articles of food.

AVERAGE CONSUMPTION

It has frequently been asserted that the people at large do as a matter of fact consume on the average about 118 grams of protein per 70 kilos of weight. But I venture to insist that the question of average protein consumption has little or nothing to do with the problem before us. To argue that the customary or the average consumption of protein is the necessary consumption suggests that the necessary potein consumption is after all far more flexible than is indicated by the standard diets. It also implies that the people have solved the problem without the aid of science, and further that their average health and vigor is now all that we can hope for in so far as the protein contents of the food have anything to do with it.

Voit, himself, remained, I think, somewhat under the strong influence of Liebig's teachings concerning the peculiar value of protein as a food. It is difficult to see how he could otherwise have failed to find that it is possible to maintain nitrogen equilibrium on a comparatively small fraction of the protein which he declared to be the minimum. It was right and natural that Voit should not put the necessary protein requirement at too low a figure; its great practical import demanded cautiousness. But the minimum protein requirement for man could of course not be found except by studying the metabolism of man under the influence of smaller and

smaller quantities of protein. This is clearly demonstrated by the results of the modern low nitrogen equilibrium experiments.

The disciples of Voit can not and do not question the accuracy of the results recorded from the low protein feeding experiments. But it is now rightly enough held that to prove that a person can maintain nitrogen equilibrium for a limited length of time, as for a few days, on a very small amount of protein does not at all prove that he can permanently do so with advantage or even with impunity. The correctness of this position must be granted, and it is, in fact, the position taken by the more conservative experimenters on low nitrogen equilibrium, as for example by Siven. But while freely admitting this, it must, in my opinon, be insisted that the low protein experiments of even such short duration, as a few days, have completely destroyed the scientific basis on which the protein prescriptions of Voit and his disciples are supposed to rest.

LOW PROTEIN EQUILIBRIUM

As far as we yet know there is no reason for assuming that a diet capable of maintaining nitrogen equilibrium for a week should fail to do so at the end of a month or any other time. In fact, investigations of the last three or four years clearly indicate that nitrogen equilibrium can be maintained for long as well as for short periods on very small quantities of protein.

In 1902 Dr. R. O. Neumann, privatdocent in the Hygiene Institute at Kiel, published an account of metabolism experiments with himself covering a period of over two years. The average composition of his diet during that time corresponded to 117 grams fat, 213 grams carbohydrates, and 74.2 grams protein per 70 kilos of body weight. Neumann's experiments covering such a long period would certainly seem to constitute definite proof that Voit's so-called minimum protein requirement is at least half again as large as is really necessary for the permanent maintenance of nitrogen equilibrium, physical vigor, and efficiency.

More striking still are the metabolism records published last year by Professor Chittenden. I shall not go into details of this work, as Mrs. Richards is on the program for a report on it. But I must cite the fact that Chittenden maintained a body weight of 57 kilos as well as nitrogen equilibrium from July, 1903, until the publication of his book in the fall of 1904, on an average protein consumption of less than 35 grams a day.

DR. FOLIN'S STUDIES

My own studies of protein metabolism in man, though pursued in a different way and for a different purpose, have a direct bearing on the problem of the necessary minimum protein consumption. The specific waste products formed from the destruction

of protein within the human organism are eliminated in soluble form with the urine. They are therefore easily available for detailed chemical investigations, and as the result of innumerable studies much exact knowledge has been gained concerning the normal katabolism products of protein. My investigations lie within this field.

The views that have till recently prevailed concerning the chemistry of urine, in so far as it relates to the problem of protein metabolism, may be concisely stated as follows: All the nitrogen of the protein destroyed in the body is eliminated with the urine, and almost 90% of it appears in the form of urea. From 95% to 98% of the nitrogen is eliminated as urea, kreatinin, ammonia, and uric acid. The absolute amount of each of these nitrogenous products depends upon the amount of protein katabolized, but changes in the amount of protein destroyed affect them all equally, thus leaving them always in about the same proportion to each other and to the total nitrogen. This fact, if correct, is very important, because it clearly indicates a certain unity in the chemical processes concerned with the use and destruction of protein within the body. It indicates that the protein of the food and the protein of the living tissues are essentially alike and in the same condition with reference to the organism at the time of their final destruction. The two rival theories concerning this subject accordingly agree in assuming the essen-

tial unity of the chemical processes involved in protein katabolism, and the only point of difference between the two is that one, the theory of Voit, holds that the protein must be in solution and dead before being oxidized and destroyed, while the other, that of Pflüger, assumes that it is only actually living protoplasm that is destroyed.

It would be useless in this connection to go into a detailed discussion of these two theories, because I think it can be shown that the fundamental premise of both, namely, the supposed constancy in the relative distribution of the urinary nitrogenous products, is no longer tenable.

RELATIVE PROPORTION OF NITROGEN WASTE PRODUCTS

The fact that the relative proportions of the various nitrogenous constituents of normal human urine have so long been supposed to be approximately constant is in a measure directly the result of Voit's teachings concerning the minimum protein requirement. The destruction of 100 grams protein or more within the organism, as demanded by the dietary standards, rendered it well nigh impossible to discover the laws that govern the formation and elimination of each product. About a year and a half ago I discovered accidentally that the urine corresponding to a very low protein katabolism has a chemical composition which is very different from that of urine derived from the standard diets. This

led to numerous attempts to reduce the daily protein destruction in normal persons to the lowest possible level.

Nearly all preceding attempts to reduce the protein katabolism have also been attempts to maintain at the same time nitrogen equilibrium. In mine the question of nitrogen equilibrium, or loss of protein, was not considered, and I have as a matter of fact used a diet containing almost no protein. I have kept several normal persons for a week or more, two or three persons for two weeks, and one for 17 days on a diet consisting exclusively of pure arrow root starch and 300 cc. of cream. In this way the daily protein katabolism has repeatedly been reduced to about 20 grams a day.

Detailed chemical studies of the urines corresponding to such greatly reduced protein katabolism have shown that the relative proportion which the nitrogenous products bear to each other and to the total nitrogen does change and very greatly. For example, the kreatinin elimination is entirely *independent* of the total amount of protein katabolized. It is just as great on a diet containing no protein as on one containing 118 grams of protein. In the one case it represents from 17% to 20% of the total nitrogen, in the other from 3% to 4%. The urea, on the other hand, is peculiarly a product of excessive protein katabolism. When the urinary nitrogen represents a katabolism of 100 grams of protein, 90% of that

nitrogen is present as urea, while when the protein katabolism has been reduced to 20 grams, only from 50% to 60% of its nitrogen appears in the form of urea.

DIFFERENT KINDS OF PROTEIN METABOLISM

These facts concerning urea and kreatinin suffice to show how entirely erroneous has been the assumption that the nitrogen of katabolized protein is always distributed in the same proportion among the different waste products. It may therefore be superflous now to go into further details concerning the laws that govern the formation and elimination of the different products. The fact that these laws are widely different for different products, as for urea and kreatinin, demonstrates with a fair degree of certainty that protein metabolism is not all of one kind.

The true minimum katabolism or protein, as obtained in my feeding experiments with starch and fats, is clearly very different from the katabolism of the large quantities of protein demanded by the dietary standards. The former converts not over 60% of the protein nitrogen into urea, and is the source of all the kreatinin eliminated with the urine. The katabolism of that food protein which is not absolutely needed for the maintenance of nitrogen equilibrium, on the other hand, yields probably at least 95% of its nitrogen in the form of urea and yields no kreatinin whatever. The katabolism

which yields the kreatinin clearly tends to be constant and independent of the food protein; it can therefore fairly be said to represent the tissue metabolism. The katabolism which yields chiefly urea is the katabolism of the excessive food protein, and its amount depends directly upon the amount of protein contained in the food. This I have called the exogenous metabolism.

EXOGENOUS METABOLISM

Since the exogenous metabolism seems to have nothing to do with the tissue metabolism, and since it increases immediately with every increase of protein furnished with the food and in porportion to such increase, it represents nothing else than the effort of the organism to get rid of nitrogen that it does not need and can not use. The remarkable ability of the human organism to establish nitrogen equilibrium on almost any quantity of protein does therefore not mean, as has been believed, that the organism uses protein by preference instead of fats and carbohydrates. This phenomenon is merely the result of our habitual consumption of more protein than can be used in the tissue metabolism. Being always supplied with an excess, we have always with us the maximum amount of reserve protein that we can advantageously carry, and any further increase in the supply simply leads to an increased elimination.

CONCLUSIONS

Such, in brief, are the conclusions which I have drawn from detailed studies of the waste products of protein katabolism.

To recapitulate: We have learned from Voit that protein is not needed to supply energy; and the work of more recent investigators has demonstrated that nothing like 100 grams of protein is needed to maintain nitrogen equilibrium in a man of average size. Further, from detailed analytic studies, we have learned that some waste products, like kreatinin, represent tissue metabolism, and others, like urea, the metabolism of that food protein which is destroyed as rapidly as it is taken in. The two kinds of metabolism are independent. The tissue metabolism is for each individual a constant quantity, irrespective of the amount of protein contained in the food. Obviously, therefore, there is a constant minimum protein requirement to prevent loss of tissue material. The amount of protein needed for this purpose is very small, probably not over 25 grams a day. It does, however, not necessarily follow that 25 grams protein should be prescribed instead of 118 grams. The prevailing idea that consumption of more than the minimum amount of protein is detrimental to health may not be true. The minimum may not be the optimum. But what has been considered the minimum, 118 grams, may be beyond the optimum, possibly even above the maximum amount of protein that any normal person should consume.

DISCUSSION

Mrs. Abel — I should like to ask Dr. Folin if he would recommend for tuberculosis patients a great deal of milk and eggs.

Dr. Folin — Any opinion I give must simply be my own. I should be inclined to think it unnecessary to prescribe any quantity of protein whatever. By that I do not mean to say how much should be consumed, because in our food products, say bread and butter, there is enough to meet all requirements as shown by these investigations, but at the same time the experience of past generations shows that we can at least, without any noticeable disadvantage, consume considerable quantities of protein. For instance, I should not advise stopping all use of meat. I should be inclined to take the same attitude toward protein as toward fats and carbohydrates. We must have enough food to maintain the energy that is consumed, and I think the same liberty can be taken toward protein as toward the other two. We do not quite know just what is the effect of compelling the system to eliminate large quantities, and so long as we do not know I do not believe we can take a very definite standpoint on the question. It is generally believed that such diseases as gout are more or less directly due to high living, but we can not prove it, and moreover it is a question whether protein consumption and meat eating are at all identical. Such products as uric

acid are formed in large quantities by meat eaters, but they are not formed when such products as milk and eggs are taken; consequently, I should say that we do not know.

In regard to such disease as consumption, I have no personal experience, but if the point is merely to build them up and give them a large amount of reserve material, we can see that it is entirely unnecessary to feed large quantities of milk and eggs, because the nutrition of milk and eggs is at once eliminated, and presumably the rest of that food is stored as fat and carbohydrates, and so I should be inclined at least to consider it worth while to try whether fat and carbohydrates would not produce just as good results.

Mrs. Abel — There are several here I think who have to do with feeding people in hospitals, and one lady with tuberculosis patients, and I should like very much for my own information to know whether these patients take and digest and seem to flourish under this high feeding of eggs and milk. I myself have to visit a poorhouse where there are 100 tuberculosis patients. Eggs are 40 cents a dozen in winter, and the state must pay for them. Still the prescription is 3 and 4 eggs a day and a large quantity of milk. If it is not necessary, it is of immense importance to the whole country to know it, for other patients need the money which now goes for this purpose.

Miss Fraser — I am trying to feed consumptive patients as economically as possible, to give them the things they like and must have and to do it all on a certain sum. Our patients are fed in the following way. They have breakfast at 7.30. We expect them to take half an hour for that meal, and they may stay as much longer as they like. At 10.30 they have their lunch of milk and eggs, no limit to the quantity of milk and eggs or egg nog. At 12.30 we have dinner. A number of patients at that meal take a raw egg and milk. At 3.30 they are called to lunch, milk and eggs. At 5.45 supper, milk and eggs again and just as much as they can eat besides. At 8.30 milk and eggs again. Some of those patients during the night take milk and eggs. We give them cereal twice a day, for breakfast and supper, cooked eight hours in a double boiler. They are very fond of that, but we find that if they know there is steak they do not take so much. The same at dinner with soups. I find they do not take as much, for they think they must save space for roast beef. Vegetables they are fond of. I try to give them as much as they can eat. They seem to have an idea that they must eat plenty of rare beef and milk and eggs. I have heard patients who have been cured, come back and say to the others "Now eat all the meat and milk and eggs that you can and never mind the other things." Farther than that I cannot tell. The patients look healthy and no

one would have any idea that they were a lot of sick people.

Miss Bevier — Would Dr. Folin say that we can not help getting from any food as much protein as the system needs and so there is no such thing as balanced rations?

Dr. Folin — If you eat enough bread and butter to give 2500 calories, I believe you would get enough protein. Be sparing of the butter if fat is too great. It is exceedingly difficult to get any diet that does not contain nutrition that is equal to the metabolism.

The one point that you would need to consider would be fuel value and in regard to that there is now perhaps a little difference of opinion. The work done by the department of agriculture is probably the safest guide at present.

Dr. Langworthy — Dr. Folin's is the most important contribution to the subject made in a long time. It clears up some matters, throws light on others and I think when work has gone on for a time longer we shall know a great deal more about this subject. I like his attitude in not drawing frenzied conclusions from so many and interesting results. I never want to forget that whenever we find a race living on a small amount of food, or largely on vegetable diet, it is not a capable race. The Italian peasants who live on corn meal and a little fish do little work, yet bring them to this country and give

them better diet and they do a great deal more and better work in a day. The second and third generation develops a larger man than his father or grandfather. We find that the Japanese eat just about the same amount of protein as the standard covers.

* * * * *

Mrs. Richards — One point which every one has very carefully left out of this discussion is the food of the child. All these experiments in lowering the food protein must be practiced on our own and not on the children's diet at present.

SUPPLEMENTAL PROGRAM ARRANGED FOR CLASS STUDY ON

FOOD AND DIETETICS

MEETING I

(Study pages 1 – 29)

The Food Problem

Food materials and their Adulteration, by Ellen H. Richards. Chapter I. ($1.00, postage 10c.)

Cost of Food, by Ellen H. Richards. Pages 1–7. ($1.00, postage 12c.)

Sanitary and Economic Cooking, by Mary Hinman Abel. Pages 1–5. (40c., postage 10c.)

Cost of Food

Cost of Food, by Ellen H. Richards. Chapters XI–XIV.

Bulletin No. 129 (Office of the Experiment Stations), Dietary Studies in Boston, Springfield, Philadelphia, and Chicago. Price 10c. (coin), of the. Supt. of Documents, Washington, D. C.

Sanitary and Economic Cooking — Some Cheap Dishes. Pages 25–33.

Rumford Kitchen Leaflets — Good food for little Money, by Ellen H. Richards. ($1.00, postage 10c.)

Principles of Nutrition and the Nutritive Value of Food. Farmers' Bulletin No. 142. (Free of Dept. of Agriculture, Washington, D. C.)

Topic: Food in Relation to National Character.

MEETING II

(Study pages 30–49.)

Food and the Body

Principles of Nutrition and Nutritive Value of Food. Farmers' Bulletin No. 142.

Food and Dietetics, by Hutchison. Chapter I. ($3.00, postage 30c.)

Food Principles

Make experiments on proteids described on pages 41 and 42.

Clean and grate a small potato under slowly running water, pour through muslin to collect fibers, let starch settle.

Exhibit: Make up an exhibit showing quantities of food having the same fuel and energy value — say 800 calories, which is a little over one-third the daily requirement for a woman at moderate work according to dietary standards. Show bread, meat, butter, milk, eggs, sugar, potatoes, apples, etc., and label each food with the weight in ounces and cost.

Calculation. Bread furnishes about 1650 calories per pound; to furnish 800 calories would require 800 divided by 1650; which multiplied by 16, equals 7.75 oz. — about half a loaf. Milk furnishes 325 calories per pound. 800 divided by 325 and multiplied by 16 equals about 40 oz., or a quart and half a pint, and so on.

Exhibit: Make an exhibit of foods containing 1.126 oz., of proteid, — one-third the daily ration for a woman — labeling each with the weight and cost.

MEETING III

(Study pages 50–61)

Dietary Standards

Food and Dietetics, by Hutchison. Chapters II and III. ($3.00, postage 26c.)

Dietary Computer, by Ellen H. Richards. ($1.50, postage 12c.)

Bulletin No. 28, American Food Materials. Price 5 cents (coin), of the Supt. of Documents, Washington, D. C.

Physiological Economy in Nutrition, by Chittenden. Introduction, Chapters IV, V, and Conclusion. ($3.00, postage 20c.)

Article in Century Magazine, February, 1905, by Chittenden

Protein Metabolism in Relation to Dietary Standards, by Folin. See Supplement, pages 196-215. See "Notes on the Questions," pages 191-195.

Send to the Battle Creek Sanitarium, Battle Creek, Mich., for some of their menus giving fuel value of food served.

See articles in Good Housekeeping,— August, 1906, "Fletcherism as Household Economy," and October, 1906, "Sense and Science in Dietetics," by Dr. Stedman.

Exhibit: Make up exhibits showing a standard day's ration for a woman with light exercise — 80 grams (about 3 oz.) of proteid — with sufficient fats and carbohydrates to bring the total fuel value up to 2300 calories. See Bulletin No. 28, American Food Materials, for composition of any foods not given in the lesson books.

(Select answers to Test Questions on Part I and send them to the School and report on exhibits and supplemental work.)

MEETING IV

(Study pages 63–116)

Special Foods

Food and Dietetics, by Hutchison, and other standard books.

Food Products of the World, by Green. ($1.50, postage 14c.)

Meat and Fish

Meats, Composition and Cooking. Farmers' Bulletin No. 34.

Fish as Food. Farmers' Bulletin No. 85.

Poultry as Food. Farmers' Bulletin No. 182.

Meat on the Farm, Butchering, Keeping, Curing. Farmers' Bulletin No. 183.

Roasting of Beef, Circular 71, University of Illinois. Isabel Bevier. (Postage 2c.)

Eggs, Milk, and Milk Products

Eggs and their use as Food. Farmers' Bulletin No. 128.

Milk as Food. Farmers' Bulletin No. 74.

Facts about Milk. Farmers' Bulletin No. 42.

Food Value of Cheese, in Farmers' Bulletin No. 244.

Milk Supply of Two Hundred Cities and Towns. Bulletin No. 46. Price 10 cents (coin), of the Supt. of Documents, Washington, D. C.

Milk and its Products, by Wing. ($1.00, postage 10c.)

Cereals and Cereal Products

Bread and the Principles of Bread Making. Farmers' Bulletin No. 112.

Wheat, Flour, and Bread. Extract No. 324.

Macaroni Wheat. Extract No. 326.

Studies in Bread and Bread Making. Bulletin No. 101. Price 5 cents (coin), of Supt. of Documents, Washington, D. C.

Cereal Breakfast Foods. Farmers' Bulletin No. 249.

Cereal Breakfast Foods. Bulletin No. 84 and 118, Maine Agricultural Experiment Station, Orono, Maine.

Pop Corn, in Farmers' Bulletin No. 202.

Corn Plants, by Sargent. (75c., postage 6c.)

Story of Grain of Wheat, by Edgar. ($1.00, postage 10c.)

Sugar

Sugar as Food. Farmers' Bulletin No. 93.

Maple Syrup and Sugar, in Farmers' Bulletin No 124.

(Select answers to Test Questions on Part II and report on supplemental work.)

MEETING V

(Study pages 119–157)

Vegetables, Fruits, and Nuts

Beans, Peas, and other Legumes as Food. Farmers' Bulletin No. 121.

Sweet Potatoes. Farmers' Bulletin No. 127.
Peanuts: Culture and Uses. Farmers' Bulletin No. 25.
Value of Potatoes as Food. Extract from Year Book, 1900.
Losses in the Cooking of Vegetables. Farmers' Bulletin No. 73.
Mushrooms as Food, in Farmers' Bulletin No. 79.
Banana Flour; Canned Tomatoes, in Farmers' Bulletin No. 119
Chestnuts, in Farmers' Bulletin No. 114.
Coffee Substitutes, in Farmers' Bulletin No. 122.
Food Value of Beans, in Farmers' Bulletin No. 169.
Nuts as Food. Bulletin No. 54, Maine Agricultural Experiment Station, Orono, Maine.
Coffee Substitutes. Bulletin No. 65, Maine Agricultural Experiment Station, Orono, Me.
Nutrition Investigations among Fruitarians and Chinese, Bulletin No. 107. Price 5 cents (coin,) of the Supt. of Documents, Washington, D. C.
Further Investigations among Fruitarians, Bulletin No. 132. Price 5 cents (coin), of the Supt. of Documents, Washington, D. C.
Food and Dietetics, by Hutchison. Chapters XIV and XVIII.
Cocoa and Chocolate. Walter Baker Co., Dorchester, Mass. (Postage 6c.)

MEETING VI

(Study pages 158 – 180)

Adulteration of Food

See Articles on "Safe Food" in the Delineator, January to July, 1906, by Mary Hinman Abel.
Food Materials and their Adulterations, by Ellen H. Richards. ($1.00, postage 10c.)
Standards of Purity for Food Products. Circular No. 17.

Use and Abuse of Food Preservatives. Extract No. 221.

Some forms of Food Adulteration and Simple Methods for their Detection. Bulletin No. 800, Bureau of Chemistry. Price 10 cents (coin), of the Supt. of Documents, Washington, D. C.

Make some of the tests described in the text and above bulletins.

Officials Charged with Enforcement of Food Laws. Circular No. 16.

The food laws of your own state. Write to the officer given in Circular No. 16 for them and send for the part of bulletin of Bureau of Chemistry containing them.

Topics: Laws, if any, in your own town. Are they enforced?
The Local Milk Supply,— investigate.
Condition of the Local Slaughter Houses.

Special Diet

Food and Dietetics, by Hutchison. Diet in Disease, Chapter XXVII.

Diet in Obesity and Fattening Diet. Chapter XXVIII.

Food as a Factor in Student Life, by Richards and Talbot. (25c., postage 2c.)

Diet in Relation to Age and Activity, by Thompson. ($1.00, postage 8c.)

A, B and Z of our own Nutrition, by Fletcher. ($1.00, postage 10c.)

Vegetarianism, by Kellogg.

(Select answers to Test Questions on Part III and report on supplemental work.)

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American School of Home Economics, Chicago.

Synopsis.

Part I. SEPTEMBER MENUS; Tables and Definitions; Processes in Cooking; General Directions; Setting the Table; Helpful Suggestions; Cost of Food and the Food Value of the Meals Served.

Part II. OCTOBER MENUS; Waiting on Table, With and Without Maid; Saturday Baking; Helpful Suggestions; Detailed Cost of Food and Food Value for Each Day, and Summary.

Part III. NOVEMBER MENUS; Dish Washing, With and Without Running Water, with Dish Washing Apparatus; *Thanksgiving Dinner* Menu, Recipes, Table Decoration and Serving; Dressing and Trussing of Fowls; Care of Fish; Methods of Cooking in Fats, Tests of Temperature, etc.; Cake Baking, Temperatures for Oven and Tests; Cost of Food and Food Value of Each Meal, and Summary.

Part IV. DECEMBER MENUS: Candy Making, Classes, Methods, and Recipes: *Christmas Dinner* Menu, Recipes, Table Decoration and Serving; Cost of Food and Food Value; Suggestions for Reducing the Cost of the Food Served.

Part V. JANUARY MENUS: Fuels and Fuel Economy, Coal, Coke, Wood, Gas, Gasoline, Kerosene, Alcohol, Electricity, Reading Gas and Electric Meters; *Informal Luncheon* Menu, Recipes, Table Decoration and Method of Serving; Fireless Cookers and Their Use; Cost of Food and Food Value; Reducing the Cost.

Part VI. FEBRUARY MENUS: Planning of Meals; A Balanced Dietary; Suitable Combinations; Economy; Suggestive Menu Chart; *School Luncheons;* The Worker's Lunch; Cost of Food and Food Value; Reduction of Cost.

Part VII. MARCH MENUS; Marketing and Cuts of Meat; *Chafing Dish Supper* Menu, Recipes, Table Arrangement and Decoration, Serving; Carving at Table; Amounts to Serve for Various Numbers; Helpful Suggestions; Cost of Food and Food Value; Reducing the Cost.

Part VIII. APRIL MENUS; Kitchen Conveniences and Appliances; *Formal Easter Luncheon* Menu, Recipes, Table Decoration, Serving; Helpful Suggestions, How to Seal Moulds, Shape Croquettes, etc.; Cost of Food and Food Value; Reduction of Cost.

Part IX. MAY MENUS: Care of Food in the Home; Care and Use of the Refrigerator; What to Do Without Ice; Care of Left-overs; Buying Supplies; Emergency Meals; *May Breakfast* Menu, Recipes, Table Decoration, Serving; Invalid Cookery; Cost of Food and Food Value; Reducing the Cost.

Part X. JUNE MENUS: Canning, Preserving, Jelly Making Recipes, Full Details of Various Successful Methods and Appliances; *Wedding Breakfast* Table Decoration, Menu, Recipes, Seating of Guests, etc.; Helpful Suggestions; Cost of Food and Food Value; Reduction of Cost.

Part XI. JULY MENUS; Pickling Fruits and Vegetables; Canning Vegetables, Recipes; *Picnic Dinner* Menu, Suggestions for Packing, etc.; *Children's Party* Menu, Recipes, Table Decoration, Methods for Serving; Cost of Food and Food Value; Reducing the Cost.

Part XII. AUGUST MENUS; Household Tests and Food Adulterations; *A Foraml Dinner* Menu, Recipes, Table Decoration, Service, etc.; Final Suggestions; Complete Index, Alphabetical with Cross References; Classified Reprint of Monthly Menus; Glossary; Bibliography.

Send 50 cents for Part I, 21 September Lessons, or ask for free Bulletin of sample pages. A. S. H. E., 506 W. 69th St., Chicago.